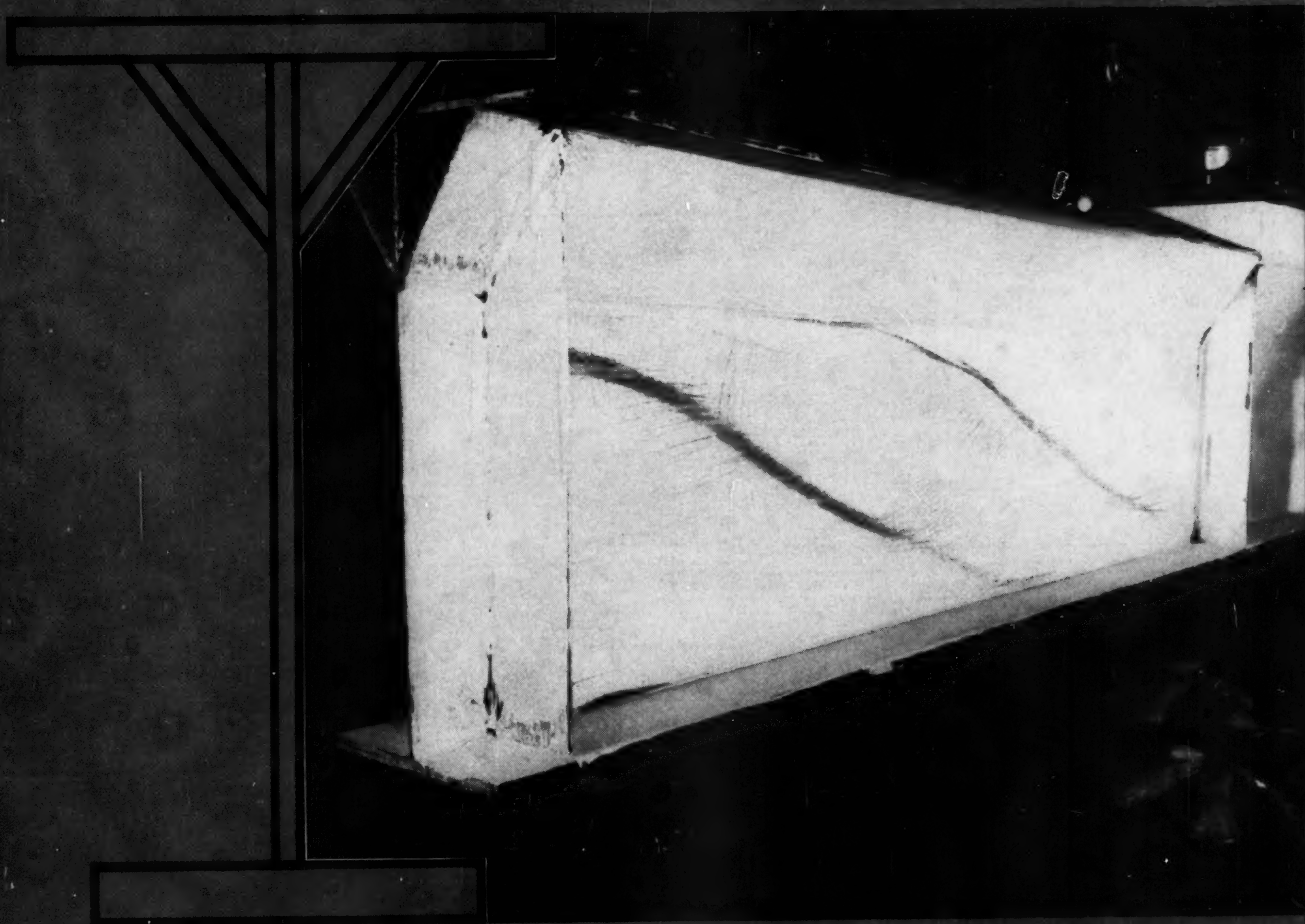
CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION • MAY 1961



AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

Delta Girder

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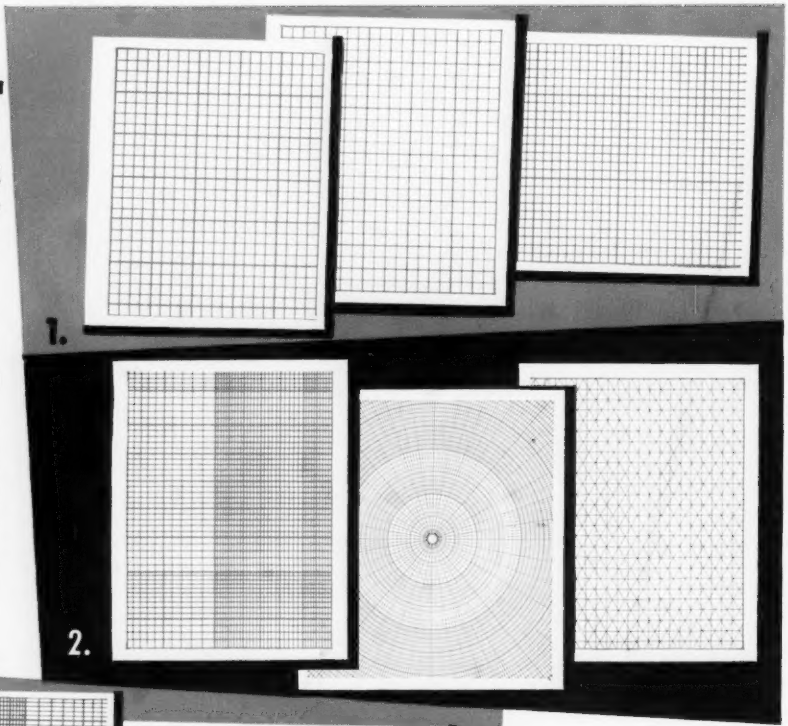

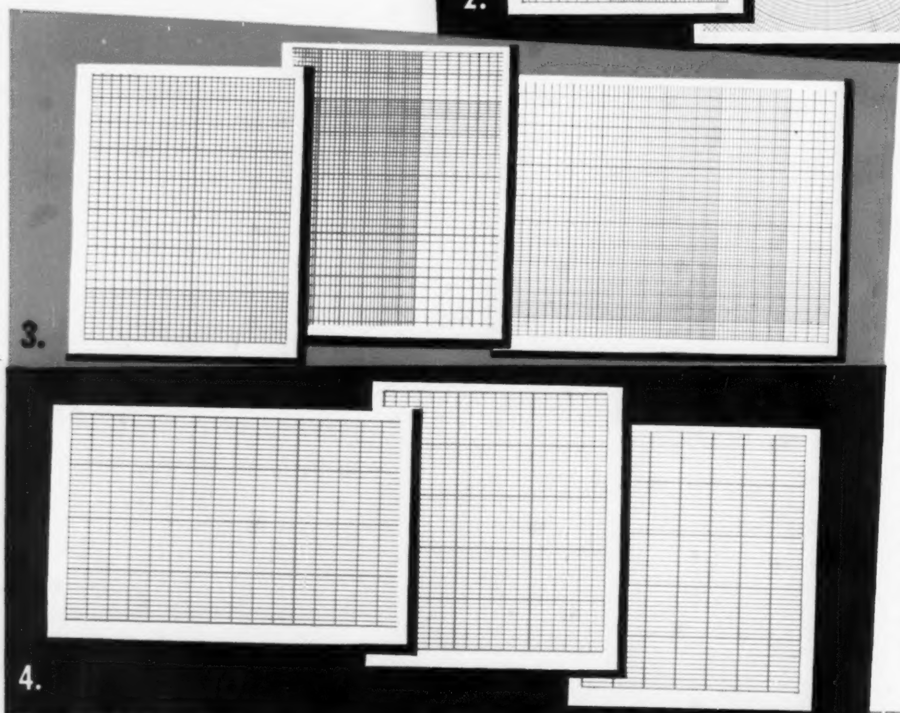

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Steel *for Strength ... Economy ... Versatility*

Texas motor hotel completed in 8 months thanks to steel framing

Much of the steel frame is left exposed and painted black, or pastel blue with striking architectural effect.

Eight months from the day they broke ground for the Carrousel Motor Hotel, near the International Airport in Houston, it opened for business . . . and the owner's investment started paying off.

A good deal of the credit for this remarkable speed record must be given to the architect's choice of steel framing for the 110 guest rooms, the large dining room, and the promenade. The steelwork not only went up fast, but also permitted all the other trades to move in quickly, and speed the motor hotel's completion.

Thanks also to the steel frame, the owner will be able to expand the hotel quickly and economically. A new steel frame can be tied in to the old one without having to put in another set of columns and losing floor area.

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CIVIL ENGINEERING

MAY 1961
VOL. 31 • NO. 5

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• ASCE NEWS

• DEPARTMENTS

Hardly! You see, Transite®, the *white sewer pipe*, is made of ageless minerals–asbestos and cement. The asbestos fibers, each with the tensile strength of piano wire, reinforce the cement to form a stone-like pipe that is rugged, tough and durable. Transite is also steam-cured under high pressure, adding further to its strength, durability and chemical stability. And, being non-metallic, there's no chance of oxidation weakening its structure. What's more, Transite's high crushing strength can withstand the heavy overburden, ground movement and earth shocks that continually challenge the ability of sewer pipe. When you add to this Transite's long lengths, tight joints and naturally smooth interior, it becomes obvious that this white sewer pipe was designed to offer greater total life expectancy.

For all the facts, write for special data file. Please indicate if you are a city official, engineer or contractor. Address: Johns-Manville, Special Sewer Data, Box 14, CE-4, New York 16, N. Y. In Canada: Port Credit, Ont. Cable address: Johnmanvil.

The Transite Pipe shown in this 23-year-old photo is still providing trouble-free service.

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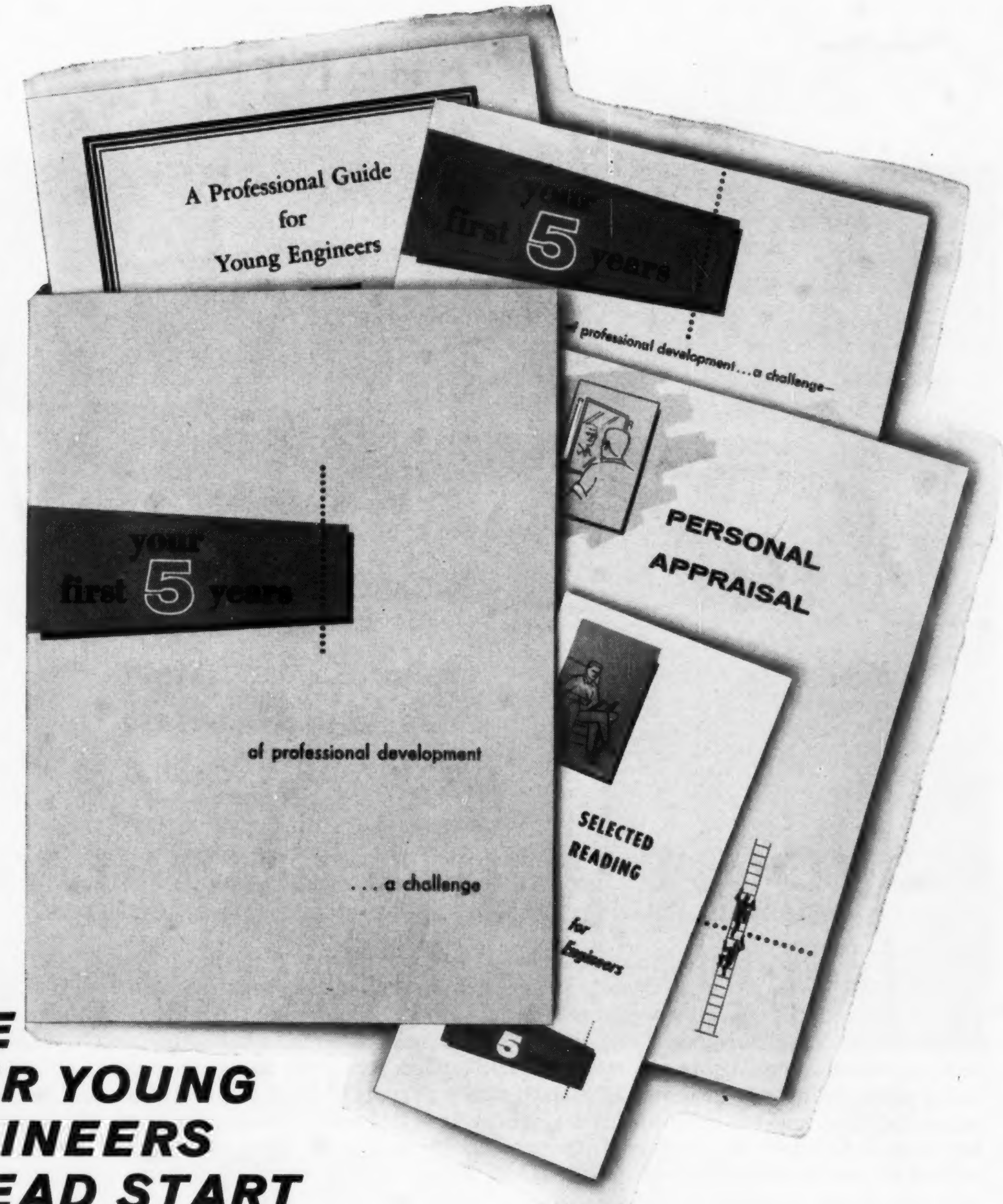
TRANSITE SEWER PIPE



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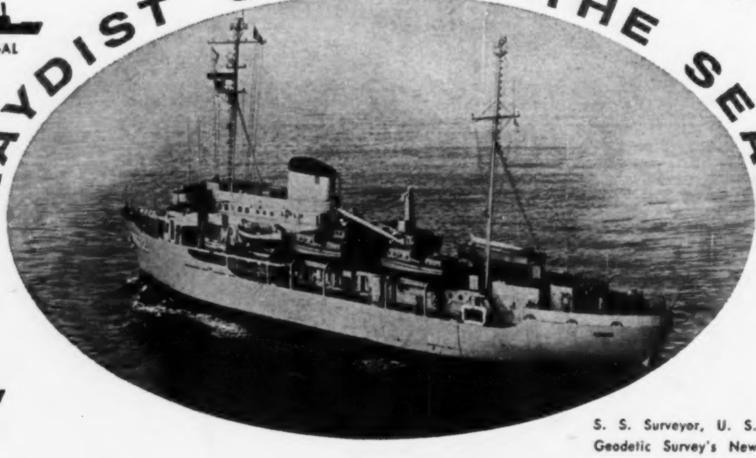

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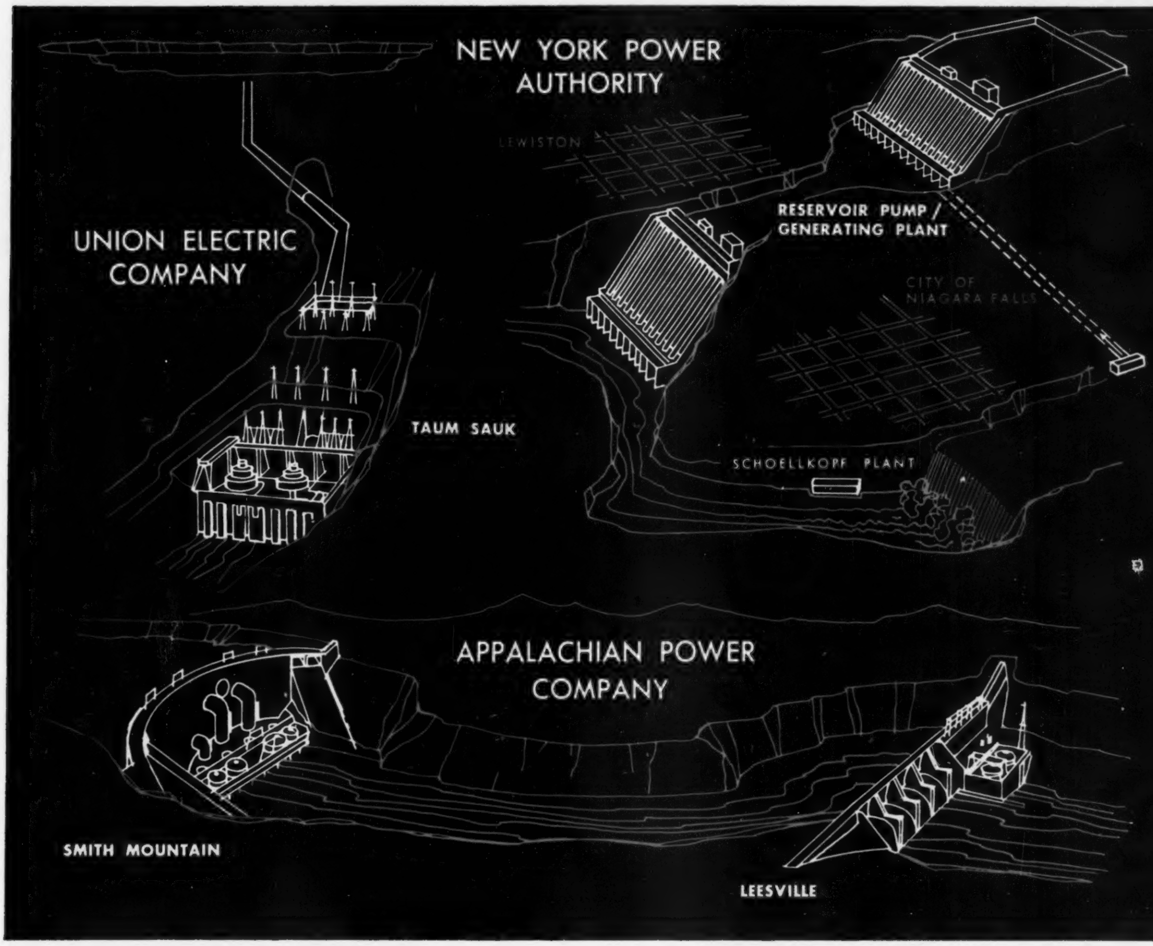


Just what you'd expect from the pumped-storage pioneer:

first in all three

Pumped-storage power projects now under construction in this country all rely on Allis-Chalmers reversible pump-turbines. In fact, A-C is the only builder of complete reversible pump-turbine equipment!

First in boosting existing hydro at Niagara Reservoir pump/generating plant! This pumped-storage project will capitalize on the hydro-electric power potential of Niagara River without adversely affecting the scenic beauty of the Falls. Largest project of its kind, this installation will include 12 reversible pump-turbines with motor-generators . . . all designed and fabricated by Allis-Chalmers. As a turbine, each unit is rated 28,000 hp under 75-ft net head; as a pump, 3,400 cfs at 85-ft total head.

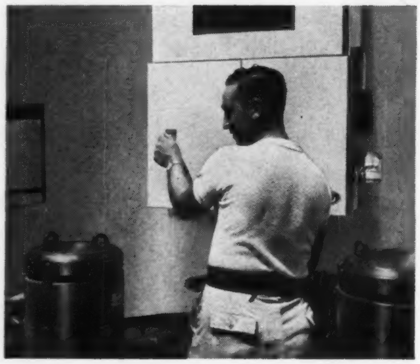
First in pure regeneration — at Taum Sauk! . . . also to have the largest-capacity hydro units ever built. Allis-Chalmers will supply two 175,000 kw reversible pump-turbines, each with a capability exceeding 300,000 hp under 800-ft head. (Pure regeneration installations need only a water supply to replace evaporative losses, so a creek is ample. Even a hill is unnecessary: the pool can be underground, in an abandoned mine shaft, for example.)

First in run-of-river — at Smith Mountain! This new project involves reservoirs at two successive levels, the lower dam forming a tailrace pool at the upper dam for two A-C reversible pump-turbines, each rated 87,000 hp at 180-ft head. Conventional hydro-generating units will also be installed — two higher-head units at the upper dam and two lower-head units at the lower dam.

For complete information on pumped-storage, hydro-generating equipment or other components for water control, contact your nearby A-C office. Or write to **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1385

Smith & Loveless Sewage Pump Stations are factory built "with the maintenance man in mind." Every detail is designed to make his job easier, faster, safer. To us, he is just as important as the engineer who specifies the station, the contractor who installs it and the buyer who pays for it.

His Smith & Loveless station comes complete with understandable maintenance and operating instructions, full color-coded wiring in the control panel, easy-to-reach starters and breaker switches, all fully identified for his safety and convenience—a dependable, patented ventilating system and humidity control, ample "elbow room" so he can work efficiently. From the minute he opens the cover on his first trip to the station, he knows the whole unit was designed with him in mind—for instance, the cover rungs that extend the ladder for his safe entry, and when he lifts the cover, the lights and ventilating blower turn on, automatically.

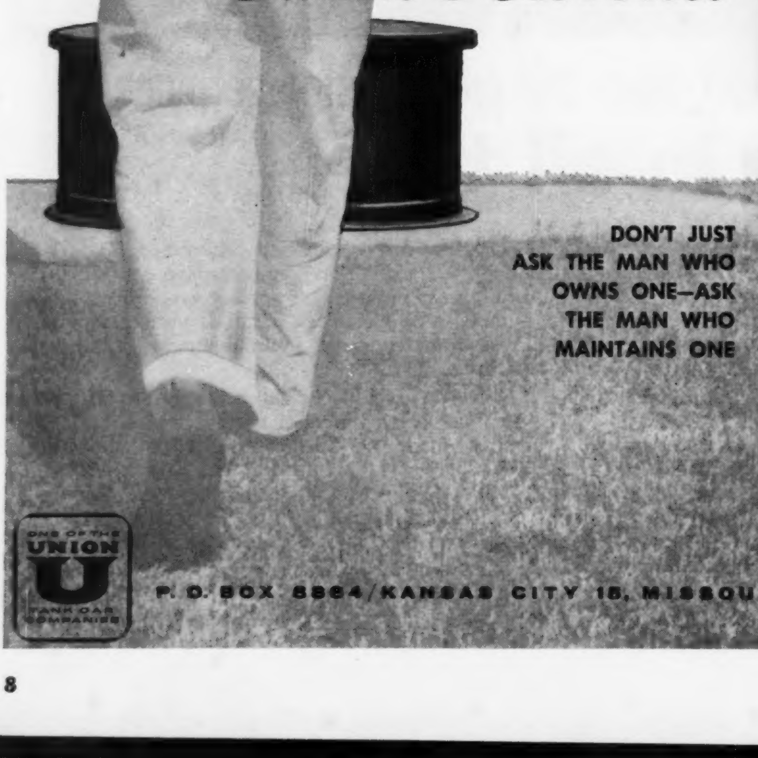


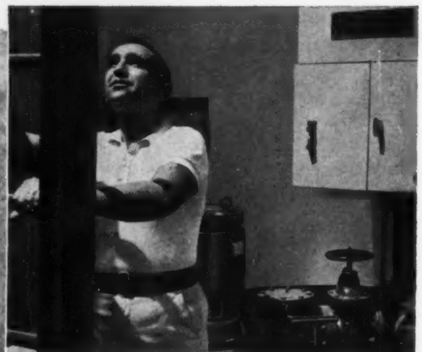
Perhaps he even "rides to work" in the pump room below, on an elevator—and inside (on the '61 models) there's even an ashtray and wastebasket for his convenience.

When inevitable wear makes it necessary to replace the dead-tight mechanical seal in that smooth-running Smith & Loveless pump, he knows it won't take long—just 30 minutes or less—a far cry from old-fashioned pump packing and seal maintenance on other pumps on the market. And, what better way to keep noxious gases, odors and sewage out of the pump room?

For the complete story on Smith & Loveless factory-built sewage lift stations—write to Department 80.

Smith & Loveless





DON'T JUST ASK THE MAN WHO OWNS ONE—ASK THE MAN WHO MAINTAINS ONE

ONE OF THE UNION TANK CAR COMPANIES

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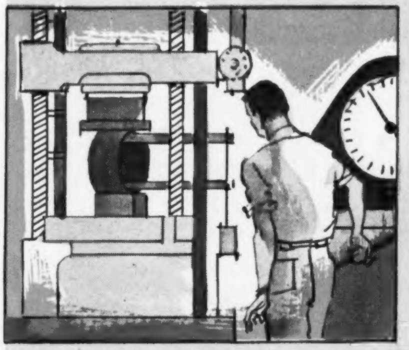
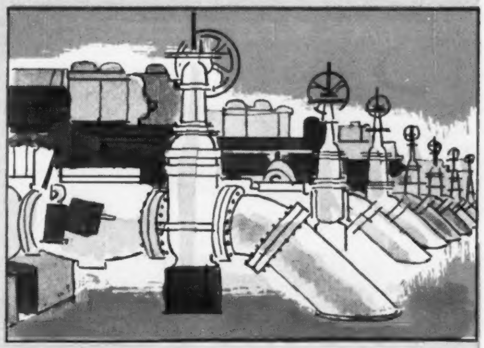
PIPE FACTS

In a recent survey, ten times as many contractors claimed more difficulty (breakage during installation) with composition pipe than with cast iron pipe.

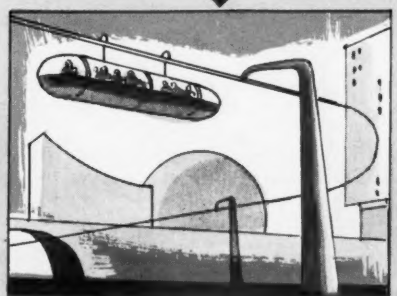
DO YOU KNOW that today's modern fire engines can pump up to 1,500 gallons of water per minute? When fire strikes, it is important that underground mains deliver the volume of water for which they were designed. AMERICAN Enamelined cast iron pipe assures high flow capacity, guaranteeing Class 150 6" pipe to have up to 13% additional carrying capacity over composition pipe of similar size and class.



DO YOU KNOW that many thousands of miles of cast iron pipe installed this year will still be serving 100 years hence? No science fiction... this is a fact! In 100 cities in America, cast iron pipe has been in service for over 100 years...and some European cities boast a record of over 200 years use.



DO YOU KNOW that AMERICAN cast iron pipe products are rigidly tested for quality and strength before shipment? In certified ring crushing tests—which indicate pipe's ability to take rugged punishment during installation and in service—samples of AMERICAN cast iron pipe withstood a crushing load of over 18,000 pounds! Similar samples of composition pipe failed at 6,480 pounds.



DO YOU KNOW that water to cool the launching pads at a U. S. Air Force missile test center is conveyed through large diameter AMERICAN cast iron supply lines? And that it is pumped through high pressure pumping stations equipped with AMERICAN flanged pipe and fittings? AMERICAN offers the most complete line of cast iron piping to meet water, sewage treatment and industrial plant service. Let us recommend the exact piping for your application.

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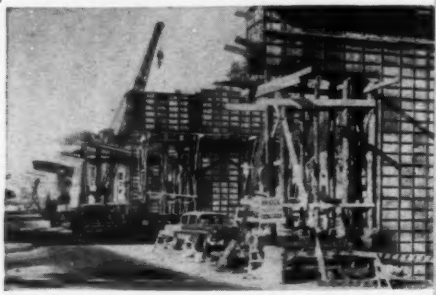


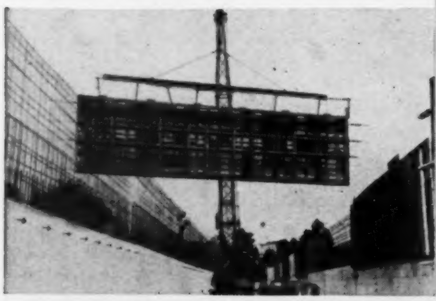

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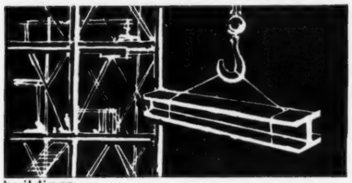
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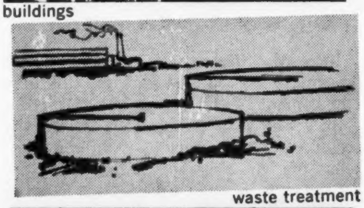
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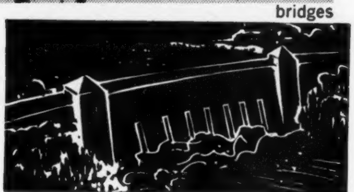
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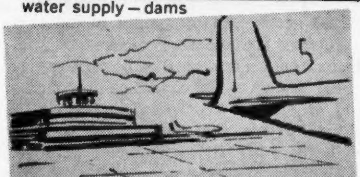
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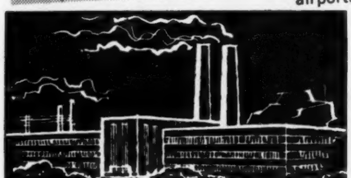
industrial plants

WHY ADVERTISING IN CIVIL ENGINEERING STIMULATES SALES IN CONSTRUCTION MARKETS

In the construction industry, four major groups account for nearly all product buying and specifying:

CONSULTANTS ■ CONTRACTORS ■ PUBLIC WORKS ■ OWNERS

Civil engineers occupy key positions in each group. Not only are they responsible for design, construction, operation and maintenance "in the field"... civil engineers are also a primary influence "behind the desk," in charge of management.

As a result of this wide responsibility, civil engineers largely control the specification and purchase of construction equipment, materials and services.

The only magazine edited exclusively to serve the technical, business and professional needs of this select audience is CIVIL ENGINEERING... official publication of the American Society of Civil Engineers.

Year after year, its circulation has increased with construction activity and the growth of the civil engineering profession. Editorially CIVIL ENGINEERING serves all areas of construction and all civil engineering interests – making it truly The Magazine of Engineered Construction.

Basic data on the civil engineer's role in different construction industry groups is being furnished by A.S.C.E. Mail Forum surveys. For example, the most recent study (of consulting engineers) revealed these facts:

■ CIVIL ENGINEERING's consultant readers own or work for firms that concentrate almost entirely on *engineered construction* projects...with their work divided among the various types of construction as follows:

Airports	3.8%	Military sites	3.9%
Bridges	7.6	Pipe lines	4.6
Buildings, commercial & residential	17.9	Rivers & harbors	1.6
Dams	2.7	Waste treatment	10.9
Highways & streets	14.6	Water supply	10.1
Industrial plants	9.1	Miscellaneous	13.2

■ the average annual cost of all the equipment and materials specified by each of the 290 firms reported is well over $6 million.

■ 90% of the readers influence the purchase and the specification of construction materials, installed equipment and office equipment.

■ their titles and functions are proof of a high degree of authority and a wide area of buying influence within their firms.

In CIVIL ENGINEERING, *advertisers reach top quality consultants concerned only with construction. This is the core of your consulting engineer market... the men who specify your products!*

And remember... whether your product is specified and purchased through consultants, contractors, architects, owners, public works officials (or any combination of these groups) you get the *most effective, most economical* coverage of civil engineers by advertising in CIVIL ENGINEERING Magazine.

Quality circulation guarantees that your product message will be concentrated on men who make the decisions that lead to purchases!... which is why we say. "advertising in CIVIL ENGINEERING stimulates sales in construction markets."

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ABC 48,000

CIVIL ENGINEERING

THE MAGAZINE OF ENGINEERED CONSTRUCTION

The American Society of Civil Engineers ■ 33 W. 39th St., New York, N. Y.

NEWS OF MEMBERS

George D. Clyde, Governor of Utah, will become the 23rd National Honor Member of Chi Epsilon Fraternity at a ceremony and banquet to be held in Los Angeles, on May 6. From 1923 to 1945 Governor Clyde was a member of the civil engineering staff at Utah State Agricultural College and for ten of those years was dean of engineering and director of the Engineering Experiment Station there. He has been Governor since 1957.

August W. Compton, widely known for his work in airport and municipal planning, administration and finance, is now president of Leigh Fisher Associates, Inc. As vice president of Clyde E. Williams and Associates, Inc., since 1953, he has had charge of planning and design for many civil and military airport projects.

A. E. McCaskey, dean of the College of Applied Science at Marshall University, has been appointed by West Virginia Governor W. W. Barron to the State Board of Registration for Professional Engineers. Dr. McCaskey is currently president of the City of Huntington Planning and Zoning Commission.

Draper K. Sutcliffe, president of Sutcliffe & Associates, with offices in Randallstown and Frederick, Md., has now opened an office at 414 Talbott Avenue, Laurel, Md. Mr. Sutcliffe first established a surveying office in 1952.

Max W. Strauss, in addition to his present duties as head of the Building Department of the City of Beverly Hills, Calif., will also administer the newly created post of director of building and planning. Mr. Strauss was first employed by the city in 1956 as assistant superintendent of building, and appointed superintendent in 1958.

Robert A. Briggs has been promoted from assistant division engineer in the steel design division to civil engineer in the Detroit Edison Company General Engineering Department. When he joined Detroit Edison 14 years ago it was as a steel designer in the design engineering department. This was followed in 1950 by his promotion to design supervisor of the steel design division and to assistant division engineer in 1956.

Robert P. Marshall, Jr., who joined the Turner Construction Company in 1940, has been elected vice president of the organization with responsibility for obtaining business in the New York area. He has served in the contract department since 1953.

Llewellyn L. Cross, Jr., was honored recently as "Young Engineer of the Year" by the Metropolitan Chapter of the Massachusetts Society of Professional Engineers, for his technical skill and professional capacities, his activities in technical and professional societies, as well as for service to his community. For the last eight years Mr. Cross has been employed by the Boston consulting engineering firm of Chas. T. Main, Inc.

William E. Willey, after 30 years as a member of the active and reserve components of the Armed Forces, recently retired as a Colonel in the Air Force Reserve. In civilian life, Colonel Willey is state highway engineer for the Arizona Highway Department at Phoenix.

IF YOUR PROBLEM IS A **SALES** PROBLEM . . .

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Many members of ASCE have important sales responsibilities in their firms. If *you* are one of them, don't overlook the basic selling power of your own magazine, CIVIL ENGINEERING.

Civil engineers, as you know, are active in all areas of engineered construction. But, in spite of their numerous functions and activities, they have a lifetime interest in their profession . . . and the construction industry! CIVIL ENGINEERING is the *only* magazine published exclusively for civil engineers.

As a reader, you do not need to be reminded of its editorial merits. However, if you are not fully aware of how *advertising* in CIVIL ENGINEERING stimulates sales of construction products and services, let us supply you with the facts.

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Jim Norton, Advertising Manager

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Leo L. Cunningham, Jasper W. Meals, and **Edwin J. Runyan,** with 15, 16 and

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Meals

Runyan

12 years of experience as staff-members of the Burns & McDonnell Engineering Company, Kansas City, Mo., are now partners in the firm. Mr. Cunningham has specialized in water works and hydraulics; Mr. Meals, in hydraulics and administrative duties; while Mr. Runyan has been in charge of the Washington, D.C., office for the past three years.

Albert G. Fiedler retired on March 9 as assistant chief of the water resources division of the U.S. Geological Survey, after 42 years of service with that organization. In January he received the Department of the Interior's highest honor, the Distinguished Service Award. Mr. Fiedler, now an engineering consultant for Edward E. Johnson Inc., will screen manufacturers in the St. Paul, Minn., area for the firm.

John F. Fleming, Jimmie E. Quon and **Robert L. Kondner** recently joined the civil engineering staff at Northwestern University's Technological Institute. Dr. Fleming as assistant professor will continue to specialize in mechanics and structures, and the application of electronic digital computers to research in these areas; Dr. Quon, last year's recipient of the Legge Award from the Northern California Section of the Industrial Hygiene Association for his work while studying and teaching at the Berkeley campus of the University of California, will further his air pollution studies at Northwestern; and Mr. Kondner, who in the past has handled teaching and research in soil mechanics at Johns Hopkins University where he has been working for his master's and doctorate, has been named an assistant. Another addition to the lecture staff is **John F. Ely,** who for the past six years has directed the Institute's big truss bridge project.

Albert N. Thompson, after 31 years of service with the U.S. Department of the Interior and the International Cooperation Administration, retired recently. In the past eight years he has served as chief of the Natural Resources Division for the Technical Cooperation Mission to New Delhi, India, and as chief of the engineering and natural resources branch of the Industrial Development Division of the Mutual Security Mission to Formosa.

(Continued on page 24)

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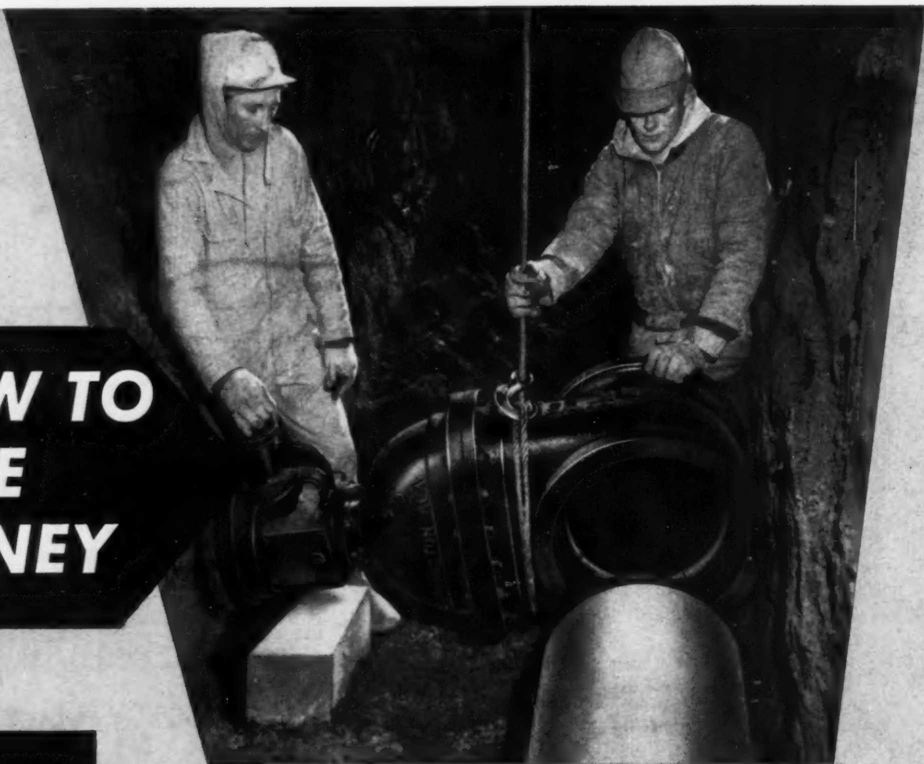
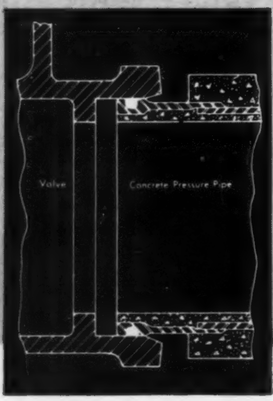


HOW TO SAVE MONEY



Cross section drawing to show position of concrete pipe spigot entering the hub of valve.

Use M&H Hub-end, O-ring Valves for Concrete Pipe

NO ADAPTERS NEEDED

MH

Eliminating the need of adapters when installing a valve in a concrete pressure pipe line saves both the purchase price and the installation expense of adapters. For a large size valve this often amounts to hundreds of dollars. That is why water works management, engineers and municipal officials are welcoming the advent of a valve with special hubs for use with concrete pipe. This valve employs an O-ring gasket to connect the valve hub directly to the spigot end of the concrete pipe. It was developed and now is manufactured by M&H Valve and Fittings Company.

This new valve for concrete pipe meets AWWA standards in every respect and is furnished in sizes 12" through 42". The valve gaskets are the same as the gaskets used for concrete pipe joints. For additional information, write for illustrated descriptive Circular No. 26.

M&H VALVE
AND FITTINGS COMPANY
ANNISTON, ALABAMA

A WALWORTH SUBSIDIARY

How McLouth Steel stores 160,000 gallons of liquid OXYGEN with negligible boil-off

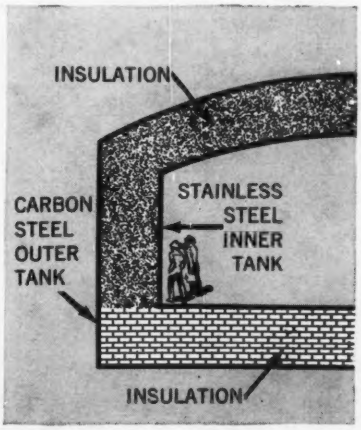
McLouth Steel Corporation needed a large-capacity vessel for storing liquid oxygen at its Trenton, Michigan mill. CB&I fulfilled the requirement with this 52 ft. diameter, specially-insulated, double-wall dome roof tank.

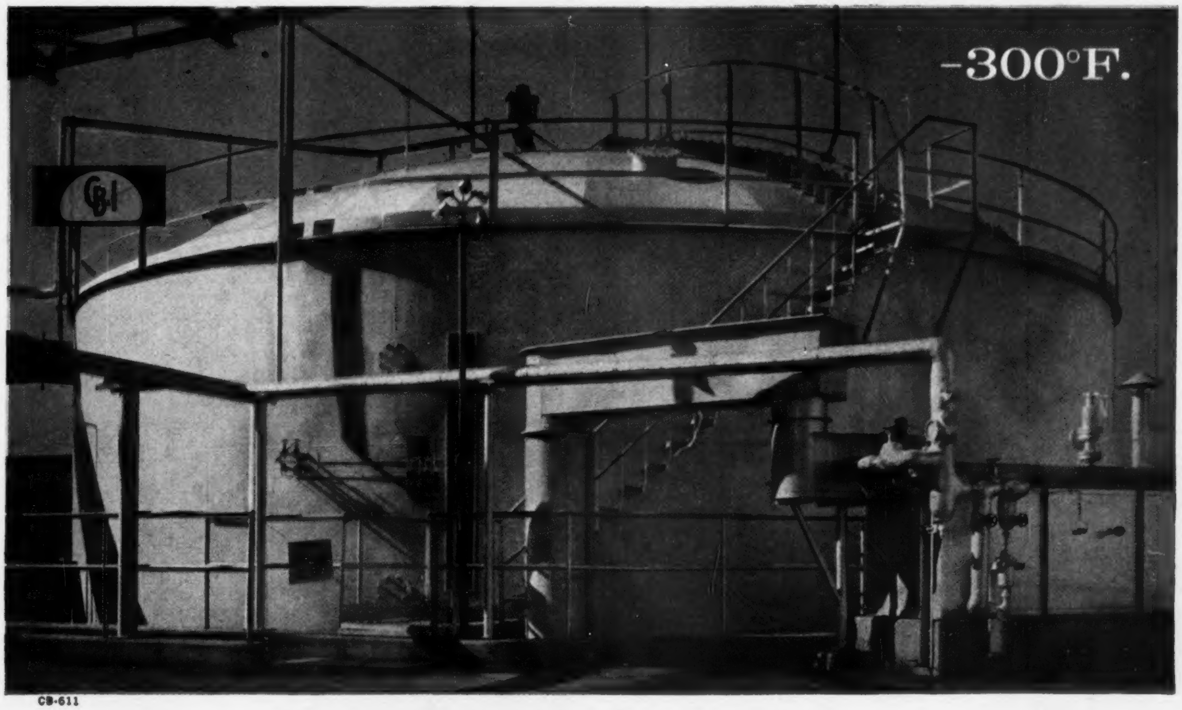
The 160,000 gallons (about 800 tons) of liquid oxygen it stores is kept at a constant −300°F. The six-foot space between the walls, twice the usual insulation provision, assures negligible boil-off.

A second tank recently completed for McLouth, is evidence of the success of this CB&I design.

You will value the depth of CB&I's experience in designing and building cryogenic storage tanks. That's why it pays to start your investigations by calling CB&I.

Write for our Brochure G-50, "Cryogenic Storage Vessels."





CB-611

CB&I Chicago Bridge & Iron Company
332 South Michigan Ave., Chicago 4, Ill.
Offices and Subsidiaries Throughout the World

TD-25'S *Full load, full pass ends load-dropping, track—*

PLANET-POWERED PUSH

—stopping steering losses

You Power-steer the International TD-25 by power-shifting either track. Full-time "live" power on both tracks, gives you full-profit production!

You make full-load turns without spillage — because Planet Power-steering eliminates load-spilling, load-limiting "dead-track drag."

With Hi-Lo on-the-go power-shifting, you shift down, to dig hard materials — shift up, to "run" with the load. When push-loading with the "25," you maintain solid contact on straightaway or curve — to speed heaping the bowls and get gear-higher "kick-outs"!

Exclusive Planet Power-steering makes the TD-25 the industry's only power-shifted 8-speed gear-drive, or 4-speed torque-converter tractor. And only the "25" is powered by the free-breathing, dual-valved 230-hp DT-817 turbocharged International diesel!

Compare bulldozing yardage delivered — time the push-loading advantages of the Planet Power-steered TD-25. Prove to yourself how "live-track" TD-25 push can multiply your "tight-bid" profits. Let your International Construction Equipment Distributor demonstrate!

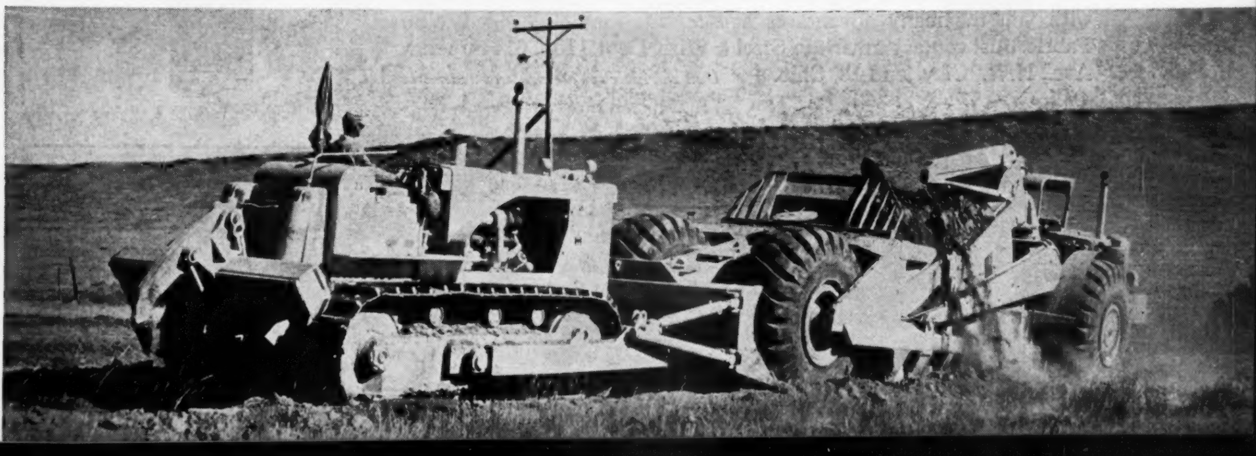
"Hanging a bench" on a mountainside, the TD-25 operator either upshifts the bank-side track — or downshifts the outside track. Then he makes full cuts under full power without "bank-nosing," rear-end skidding, or "lever fighting."

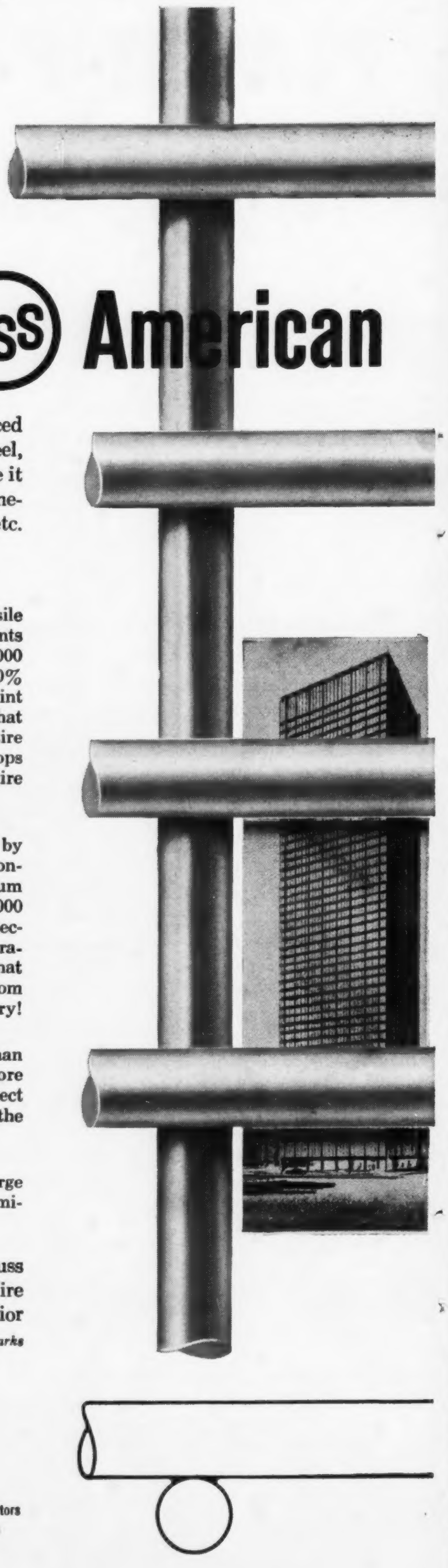
Moving thousands of tons of outcrop shot-rock for mountain road right-of-way, this TD-25 picks up and delivers its full loads without sluing or slipping. Reason: with Planet Power-steering you run one track in high, the other in low speed range to equalize offset loading. And you steer with full power on both tracks full time — to avoid load-dropping interruptions!

Power-gaining Planet Power-steering helps you heap-load scrapers in record time — right where clutch-steered pushers lose half their push! Power-shifting either track up or down keeps solid push-block contact on curves. Power-shifting up, on-the-go, gives gear-higher kick-outs than ordinary. And with 7.5 mph reverse, the "25" repositions faster than slower rigs!

International® Construction Equipment

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.
A COMPLETE POWER PACKAGE





It's new... it's big... it's strong...

extra-heavy ½ inch USS American

Welded Wire Fabric is now available with ½" diameter wires spaced as close as 2" on centers in both directions! These new areas of steel, plus the many time-tested advantages of Welded Wire Fabric, make it the ideal structural reinforcement for all types of construction—one-way slabs, two-way flat plates or flat slabs, walls, slabs on grade, etc.

Consider these advantages:

1. American Welded Wire Fabric is produced from cold-drawn high tensile steel wire. This wire is carefully produced to conform to the requirements of ASTM Specification A82-58T. The minimum tensile strength is 75,000 psi and the minimum yield point, as defined in this specification, is 80% of the tensile or 60,000 psi. Actually, cold-drawn steel wire has no yield point in the conventional sense—no sudden excessive elongation. This means that cold-drawn wire tends to resist stress practically throughout its entire strength range without revealing any sudden elongation such as develops in a typical hot-rolled bar. This physical advantage of cold-drawn wire makes it the ideal concrete reinforcement.

2. American Welded Wire Fabric is completely machine prefabricated by electrically welding all wire intersections. The strength of these welds conforms to ASTM Specification A185-58T which requires that the minimum average shear value of the weld in pounds shall not be less than 35,000 multiplied by the area of the longitudinal wire. This high-strength connection assures positive "mechanical anchorage" in the concrete. In fact, laboratory tests reported in the ACI Proceedings, Vol. 48, April, 1952, show that this anchorage is so good that fantastically high bond stress values from 1000 psi to 2700 psi are computed using conventional bond stress theory!

3. American Welded Wire Fabric is prefabricated with greater accuracy than can normally be relied upon in field work. The wires may not vary more than ¼" center-to-center than the specified spacing. This assures correct placement and distribution of the steel. Also, the wires are drawn to the very close tolerance of 0.003".

4. American Welded Wire Fabric requires very little on-the-job tying. Large prefabricated sheets are shipped to the job and placed as a unit. This eliminates thousands of ties and results in important labor savings.

The representatives of American Steel & Wire will be pleased to discuss with you the many advantages and applications of Welded Wire Fabric. Just contact American Steel & Wire, Dept. 1151, 614 Superior Ave., N.W., Cleveland 13, Ohio. *USS and American are registered trademarks*

USS

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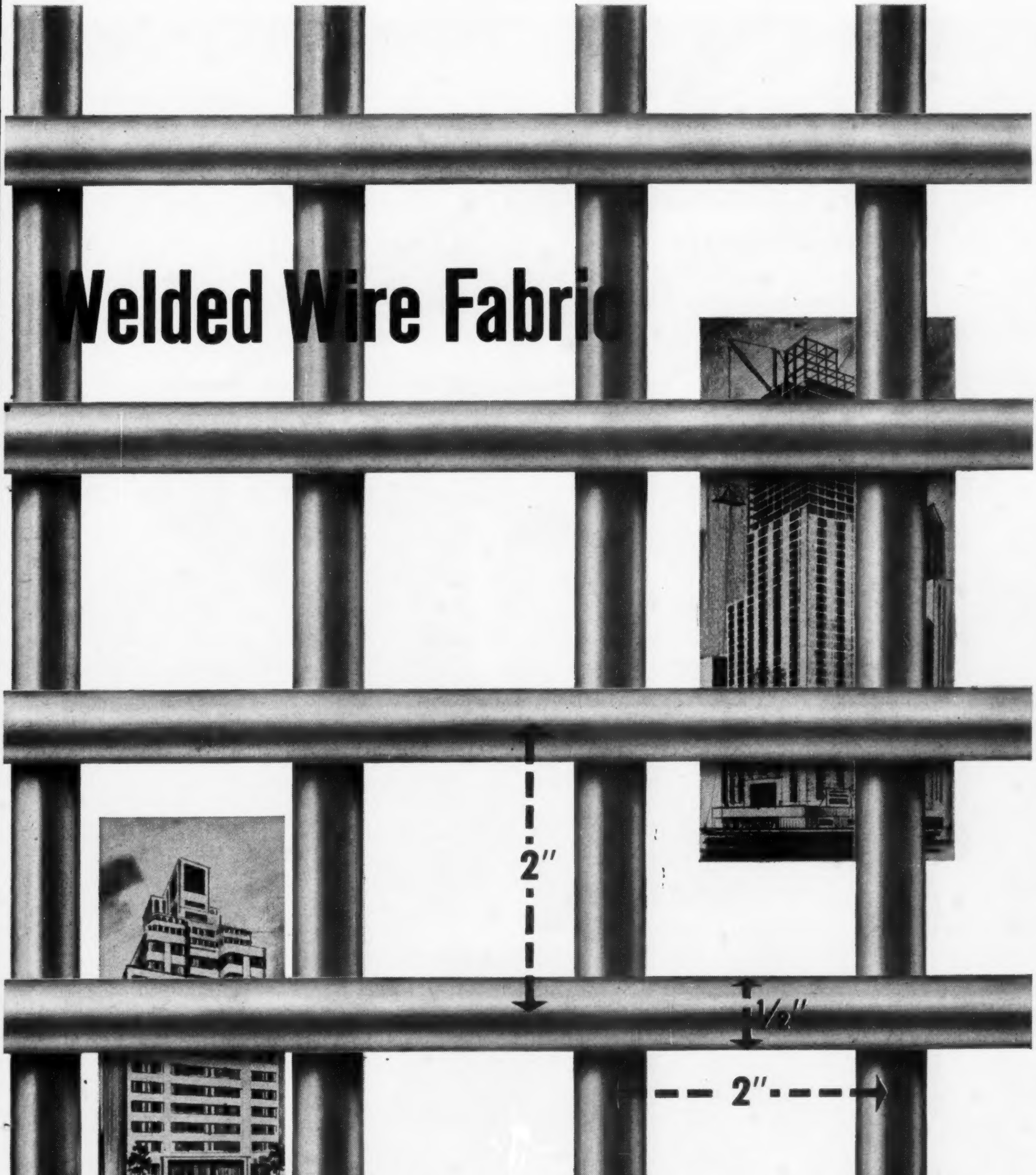
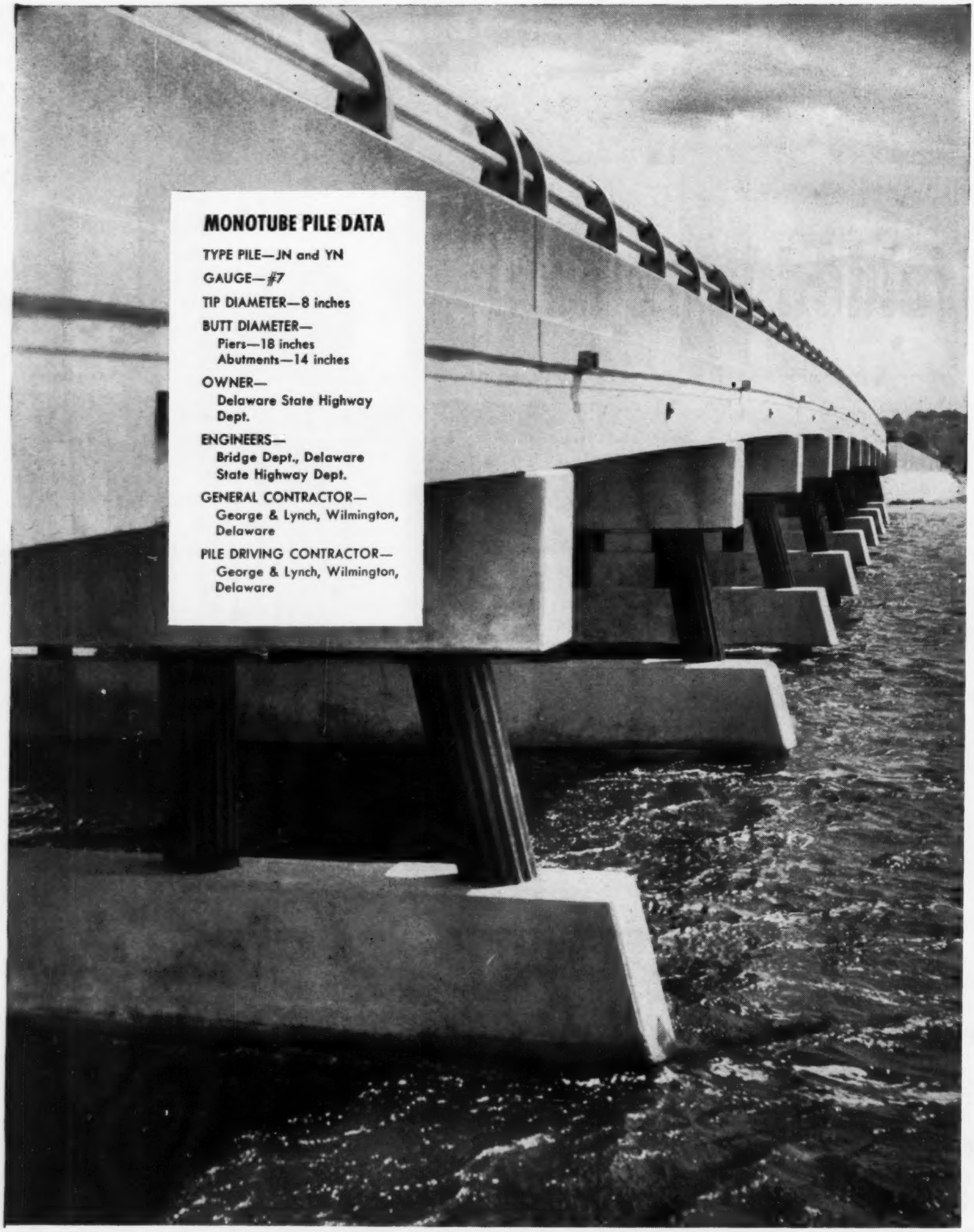

Welded Wire Fabric
2"
1/2"
2"



DESIGN ECONOMY AND CONFIDENCE with Monotube Piles . . . acting both as piers and foundations for this prestressed concrete beam bridge at Fenwick Island, Delaware. The high columnar strength of Monotubes makes their application ideal for this type of project.

Tapered, fluted Monotube steel piles are available in lengths, diameters and gauges to meet your requirements. The Union Metal Manufacturing Co., Canton 5, Ohio—Brampton, Ontario, Canada.

UNION METAL

Monotube Foundation Piles

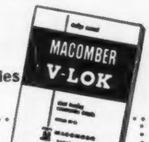
These 3 standardized V-LOK components... plus a sledge

...give you a strong, rigid frame in days, not weeks!

V-LOK interlocks! No field welds, no bolts, no rivets needed. Just a sledge blow seats V-LOK'S deep end connections securely. No wonder V-LOK buildings break all records for framing and roofing in! The V-LOK system is variable to meet every design and function requirement . . . V-chord sections are **nailable** for faster, easier decking.

FREE . . .
Complete design manual!

- Structural analysis • Load Tables
- Typical framing plans, etc.



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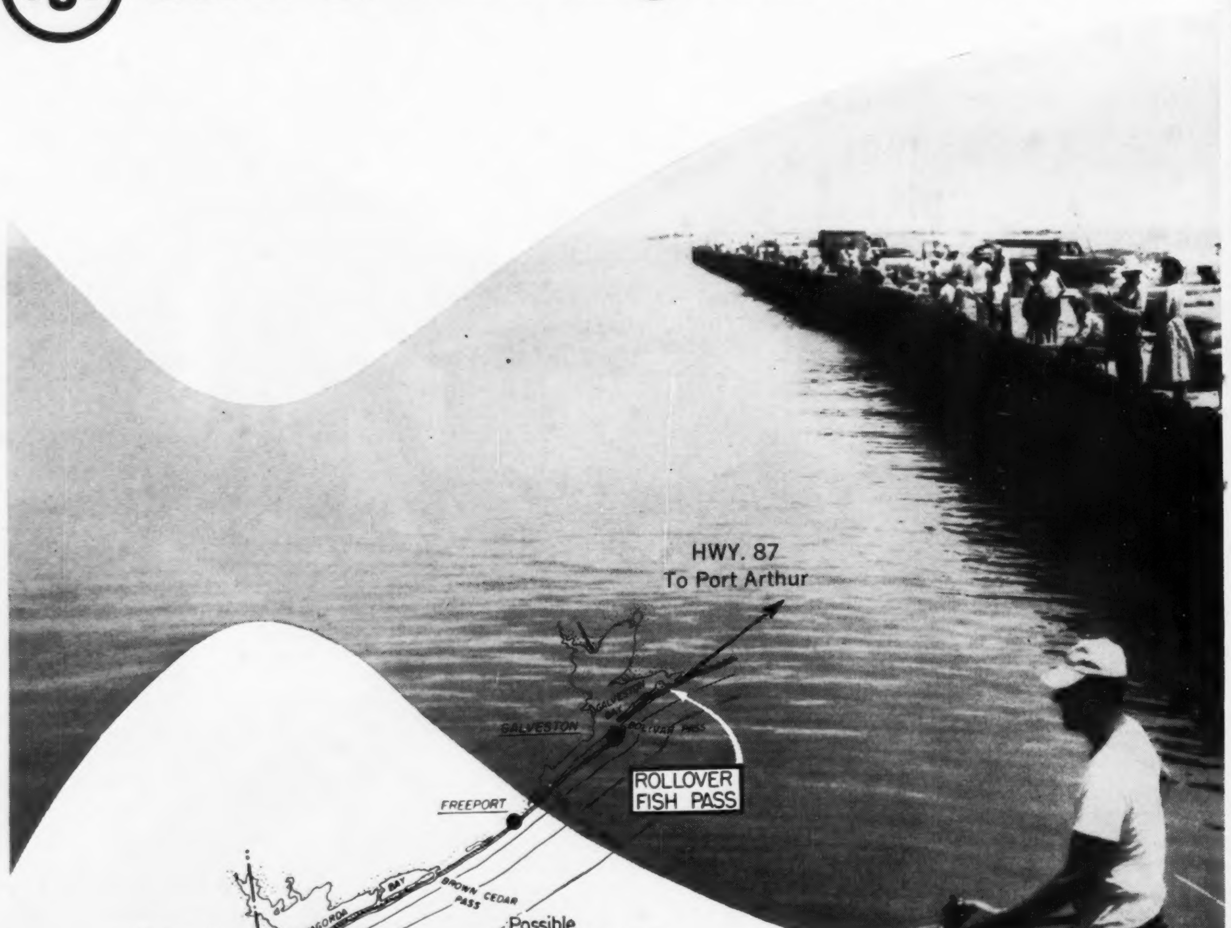
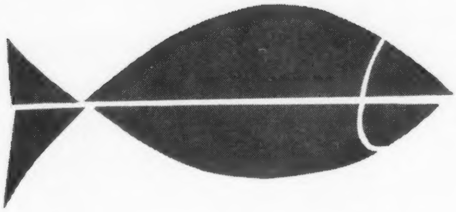
USS Steel Sheet Piling cuts off erosion

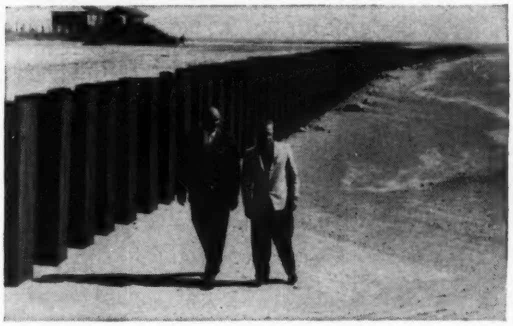


because it's strong
because it's durable

at Rollover Fish Pass



● Rollover Fish Pass is a narrow, man-made channel that runs through a barrier island off the coast at Galveston, Texas. It was dug several years ago by the Texas Game and Fish Commission to connect the Eastern Arm of Galveston Bay with the Gulf of Mexico as part of a long-range program to improve commercial and sport fishing in the bays of the Texas Coast. Artificial waterways like Rollover improve the salinity balance of the bays and open new spawning grounds. ● At first, Rollover Pass caused trouble. Powerful tidal currents eroded the sides and widened the channel causing damage to adjacent property and endangering bridges on State Highway 87. Remedial action taken consisted of driving steel sheet piling along the sides of the Pass to stop erosion. Two steel sheet pile sills were also driven across the pass to keep the channel from scouring. Over 1500 tons of USS steel sheet piling were used for the job. ● Joe Marks, Chief Engineer for the Texas Game and Fish Commission, said, "United States Steel sheet piling was selected because of its strength and economy. I fully expect this steel sheet piling to have a long and useful life." ● Today, Rollover Fish Pass is one of the most popular fishing spots in the area. As many as 5000 people have fished here in one day. And the Pass has attracted new businesses, too—restaurants and motels have sprung up nearby. Mr. Marks said, "The operation of the pass is highly successful and fishing results have been excellent." The success of Rollover Pass has prompted the Commission to move ahead on plans to excavate additional inlets through the barrier islands along the Texas Coast. ● If you need steel piling—steel sheet piling, pipe piles or H-Piles, call the nearest U. S. Steel Office, or contact United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.



Fred T. Hankey, Jr. and Joe Marks of the Texas Game and Fish Commission inspect steel piling installation at Rollover Pass.

United States Steel Corporation, Pittsburgh • Columbia-Geneva Steel, San Francisco • National Tube, Pittsburgh • Tennessee Coal & Iron, Fairfield, Alabama • United States Steel Export Co.

USS TRADEMARK **United States Steel**

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News of Members

(Continued from page 13)

Anton A. Pregler retired recently at age 70 as chief of operations engineering for the New York regional office of the Public Housing Administration. A career official in the federal service most of his professional life, he joined the Treasury Department in 1934, and the housing program in 1935 where he has remained since. In the near future Mr. Pregler plans to open a private consulting practice.

William C. Ackermann, chief of the Illinois Water Survey since 1956, was recently elected national president of the hydrology section of the American Geophysical Union for a three-year term, effective July 1. He has been vice president of the hydrology section since 1958. Also he is professor of civil engineering at the University of Illinois. Elected to serve with Mr. Ackermann as vice president is **David K. Todd,** associate professor of civil engineering at the University of California at Berkeley.

Edward F. Koenig has been elected president of the Civil Engineers and Land Surveyors Association of California. Mr. Koenig, vice president of the Engineering Service Corporation, Los Angeles, over the past 15 years has participated in some of the largest community development projects in the nation, and is presently supervising development of 7,000 acres of virgin land on the Palos Verdes (Calif.) Peninsula.

Urban Engineers, Inc., in the future will conduct its civil and structural engineering consulting work through its new offices at 1619 Chestnut Street, Philadelphia, Pa. Included on the staff are **Edward J. D'Alba,** chief civil engineer and vice president, **K. Yervant Terzian,** chief structural engineer and secretary, and **Thomas Buckley,** staff consultant.

Donald W. Giles on March 1 began his duties as a full time planner for Wayne Township in New Jersey. The first to serve in the newly created post, he is qualified on the basis of past work on master plans for Bridgeport, Conn., and New Castle County and Wilmington, Del.; plus studies of traffic and parking and highway relocation.

Felix Kulka, structural engineer with T. Y. Lin and Associates of Van Nuys, Calif., will direct the activities in prestressed concrete design and construction of the firm's new branch office at 3106 Fillmore Street, San Francisco.

De Leuw, Cather & Company, consulting engineers with offices in several cities, has reorganized its board of directors to include its founder and president, **C. E. De Leuw;** the executive vice president, **L. H. Cather;** and five vice presidents, **R. H. Anderson, J. E. Linden, W. R. McConochie, R. B. Richards,** and **V. E. Staff.**

Howard Kent Preston, formerly professor and head of the department of theoretical and applied mechanics at the University of Delaware, now retired, was presented the "Delaware Engineer of the Year" award at the recent annual banquet of the Delaware Council of Engineering Societies. The citation paid tribute to him "for a lifetime of service to engineering education, for extensive personal participation in and support of technical society activities . . . and for support of engineering as a profession."

Richard Browne, Mayor of Wayne, N.J., and a partner in Fred W. Gardner and Associates, of Clifton, N.J., is one of five persons cited as "Outstanding Young Men of 1960" by the New Jersey State Junior Chamber of Commerce. A "well balanced record" in local government and in the civil engineering profession was the basis for his selection.

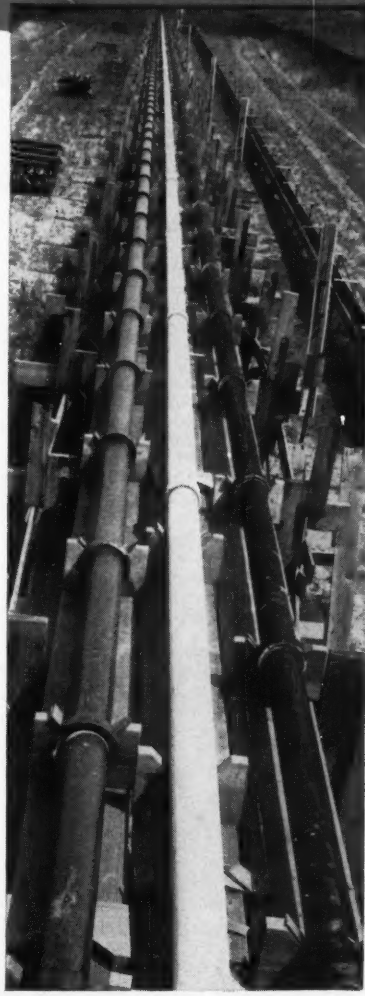
Judson P. Elston, for the past six years project foundation engineer with Uhl, Hall & Rich on the St. Lawrence and Niagara Power Projects, has resigned to accept the post of chief engineer with the Selby Drilling Corporation in Boise, Idaho. He was head of the grouting design group in the Denver office of the Bureau of Reclamation where he was employed for 19 years, and as project manager for Chas. T. Main, Inc., he recently spent seven months in West Pakistan.

W. Turner Wallis as special consultant to Gee & Jensen, of West Palm Beach, Cocoa and Fort Myers, Fla., will handle the administrative and fiscal aspects of water resources management. He was executive director and chief engineer for the Central and Southern Florida Flood Control District from 1949 to 1957, engineer for the Trustees of the Internal Improvement Fund in 1956, and in 1958 founder of his own consulting association.

John W. Courter (left), Arkansas division engineer for the Bureau of Public Roads, has been awarded the Department of Commerce Meritorious Service Silver Medal, for outstanding service during his 31 years with the Bureau in furthering the nation's highway programs. Making the presentation is Bill L. Andrews, assistant regional engineer of the Bureau of Public Roads at Fort Worth, Texas. Mr. Courter is a director of the Mid-South Section and a past president of the Little Rock Branch.

(Continued on page 26)

EXTENSIVE TESTS ESTABLISH VALUES for MANNING's n



There has been considerable loose talk lately about "new" values for Manning's *n* when figuring flow coefficients for sewer lines. Manufacturers of one substitute material for lifetime Vitrified Clay Pipe say their pipe has a lower *n* factor, allowing flatter grades or smaller diameter pipe.

Independent tests show that this is not true.

For example, the new "Design and Construction of Sanitary and Storm Sewers"* manual contains a table entitled "Suggested Values of *n* for Manning's Formula." According to this table in the *new standard* for sanitary engineers, the range of values for *n* is ***exactly the same*** for lifetime Vitrified Clay Pipe and all normally used substitutes for this material.

Extensive tests just completed by independent researchers demonstrated this same point, as do other independent studies quoted at length in the manual.

Remember, there is no substitute for research. And there is no substitute for lifetime Vitrified Clay Pipe in your sewer lines.

**Prepared by a Joint Committee of the Water Pollution Control Federation and the American Society of Civil Engineers, 1960.*

COMPRESSION SEALED, VITRIFIED
CLAY IMPERVIOUS PIPE
THE STANDARD in SANITARY SEWERS

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Ave., Washington, D. C.

Please send me full details on the new factory-made compression joints on Clay Pipe.

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B-3C23 CE

NATIONAL CLAY PIPE MANUFACTURERS, INC.
1028 Connecticut Avenue Washington 6, D. C.

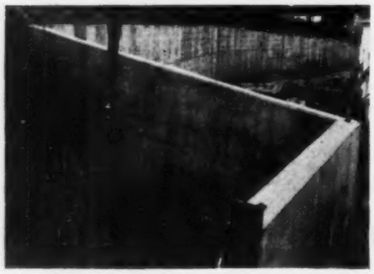
Battered Walls

Symons Steel-Ply Forms Solve Complicated Wall Problem

952 Ties Required . . . 186 Different Sizes

Alvey & Eldridge Construction Company to save time in pouring a battered retaining wall 202 feet long in Kansas City, used Symons Steel-Ply Forms. The contractor rented 2,400 square feet of forms to pour the 4,800 square feet of forming. This amounted to 204 cubic yards of concrete.

The Symons system particularly showed its versatility on this complicated wall with the use of Symons Ties. 952 ties were required. And it was necessary to furnish 186 different sizes.



Completed section of battered wall. Note the clean, smooth finish.

Upon completion of the job which was done for Skelly Oil Company, Roy Eldridge, president of the firm was so well pleased with the performance of the Symons Steel-Ply Forms that he purchased the 2,400 square feet. You too may want to try Symons Steel-Ply Forms on a rental purchase plan. Write for details. One of our sales engineers will be happy to call at your request.

Symons

SYMONS CLAMP & MFG. CO.

4295 Diversey Ave., Dept. E-1, Chicago 39, Ill.

Warehouses Thruout the U.S.A.

*MORE **SAVINGS** FROM **SYMONS***

News of Members *(Continued from page 25)*

James C. Marshall, Brigadier General (retired), Corps of Engineers, has been appointed by Minnesota's Governor, Elmer L. Andersen, state highway commissioner for a four-year term. In recent years, General Marshall has worked on projects in New York City, Turkey, Venezuela, with the Comilog Project in French Equatorial Africa (now Gabon), and in Paris.

Reginald Carrier Price, the new deputy director for the California Department of Water Resources, until recently was with the International Cooperation Administration in Seoul, Korea for three years as deputy assistant director of Program and Economic Policy, U.S. Operations Mission. During a previous three-year period he was director of the Department of the Interior's Division of Water and Power.

J. M. Fisher, Jr., formerly a plastic tool engineer with the Douglas Aircraft Company in Honea, S.C., has joined the Durham office of the Duke Power Company as an industrial development engineer. He will operate in the northern area of the Duke Power System, devoting full time to attracting new industry to the Carolinas.

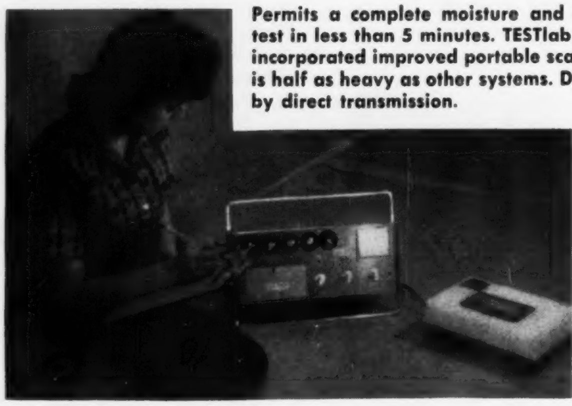
E. F. Clark has completed an assignment as a member of the United Nations transportation study team sent to Caracas, Venezuela, to review socio-economic problems prior to developing a comprehensive transportation plan for the region. At the present time, Mr. Clark is New York State Director of Highway Transportation.

Brother B. Austin Barry, a recognized authority on surveying and mapping was installed recently as president of the American Congress on Surveying and Mapping, having served this past year as its national vice president. Currently, associate professor of civil engineering at Manhattan College where he has been a staff-member since 1943, Brother Barry, under ASCE sponsorship, has headed a Task Committee on the Status of Surveying and Mapping in the United States and for several years has been secretary of the Metropolitan Section.

(Continued on page 28)

TESTlab NUCLEAR SOIL TESTING SYSTEM

Permits a complete moisture and density test in less than 5 minutes. TESTlab system incorporated improved portable scaler and is half as heavy as other systems. Densities by direct transmission.



Surface Moisture Gage and Scaler. System illustrated weighs 34 lbs.

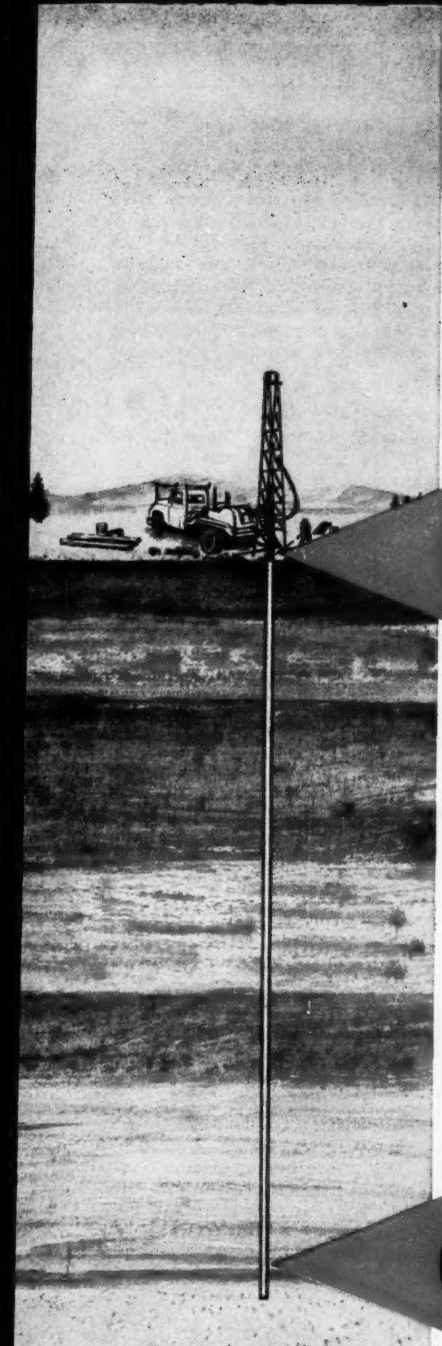
TESTlab CORPORATION

3398 Milwaukee Avenue
Chicago 41, Illinois
Phone—MU 5-0006 Cable—TESTlab

Represented in Canada and most foreign countries.

Write, phone or wire for information or appointment for demonstration

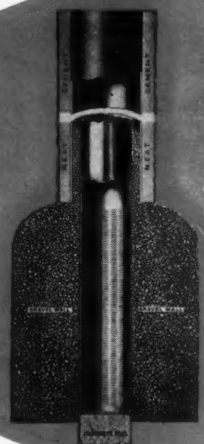
12 page illustrated brochure completely describing our Nuclear systems, VoluTESTer and related equipment available upon request.



Layne
SINCE 1882

has the only complete service that means Water

Layne Vertical Turbine Pumps are designed, engineered and manufactured by Layne in Memphis, Tennessee and nowhere else. Because pumping needs vary, there is a Layne pump for every pumping requirement—from 30 to 100,000 G.P.M. in sizes from 4 to 42 inches. Layne Pumps include Deep Well and Short Coupled (oil or water lubricated), Propeller, Mixed Flow, Regular and "In-Line" Submersible. For additional information write for bulletins 200-oil lubricated or 201-water lubricated.



The Layne Gravel Wall Well is an example of Layne experience, engineering and research. This gravel packing and 134 shutter screen employment affords larger screen openings, reduced friction, reduced draw down and pumping head. It increases specific capacity and makes for more effective retention of native sands. For additional information write for bulletin 900.

From top to bottom, you can depend on Layne for the most complete water service in the industry. This complete service provides undivided responsibility for the delivery of water . . . of the quality and in the quantity required. Over 75 years of *growing* service gives the skill and technical know-how which makes Layne First in the field of water. For additional information write for bulletin 10.

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OFFERS COMPLETE
WATER SERVICE:

Initial Surveys • explorations • recommendations • site selection • foundation and soil-sampling • well drilling • well casing and screen • pump design, manufacture and installation • construction of water systems • maintenance and service • chemical treatment of water wells • water treatment—all backed by Layne Research.

Layne services do not replace, but coordinate with the services of consulting, plant and city engineers.

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LAYNE ASSOCIATE COMPANIES THROUGHOUT THE WORLD
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News of Members

(Continued from page 26)

T. A. Bedford, for most of the past five years vice president in charge of engineering and construction project development for Kaiser Engineers, in his new capacity as president and director of the Henry J. Kaiser Company (Canada), Ltd., will direct the firm's expanded engineering and construction activities throughout Canada.

William A. Sandberg, formerly president of the Sandberg-Serrell Corporation, has accepted a position as a member of the Senior Staff of the National Engineering Science Company of Pasadena, Calif.

Bennett W. Burns, following his recent resignation from the firm of H. E. Bovay, Jr., where he has been a partner for the past nine years, has opened an office for the practice of civil, structural and mechanical engineering at 1537 Tennessee Building, Houston, Texas.

Howard M. Post has resigned as resident engineer for the Florida State Road Department of Miami, to join **Robert Schuh** in a consulting and surveying practice. The new firm, to be known as Post and Schuh, Inc., will have its headquarters at 355 Westward Drive, Miami Springs, Fla.

Rolf Eliassen, an authority on sanitary engineering, joins the Stanford University faculty as professor of civil engineering on September 1. Dr. Eliassen is now acting head of the department of civil and sanitary engineering at the Massachusetts Institute of Technology, where he has been since 1949. Internationally known for his studies on the disposal of atomic wastes, he is a consultant to the U.S. Public Health Service and the International Atomic Energy Agency of the United Nations.

F. M. Albrecht, who retired with the rank of Major General from the Corps of Engineers last year, has accepted a temporary assignment in East Pakistan as a consultant with Transportation Consultants, Inc., a Washington firm. General Albrecht will make a survey and study of existing water borne transportation facilities in the area as part of the State Department program of economic cooperation with other countries. As division engineer for the Corps of Engineers with headquarters in Atlanta, Ga., from 1957 to 1960, he has had a wealth of experience in such work.

Kenneth R. Wright, formerly a partner in the water engineering firm of Wheeler and Wright, announces the formation of Wright Water Engineers in Denver, Colo. The new firm offers various services in the field of hydrology.

. . . . . *Am-Soc Briefs*

▶ ▶ Phoenix Convention -- tops! This is the word members returning from Arizona have for the Society's latest (April 10-14) Convention. There is praise for the weather, balmy and beautiful as promised; for the Westward Ho, headquarters hotel, with its exotic patio; for the Glen Canyon-Grand Canyon trip; most of all, for the job done and hospitality offered by Convention committees headed by Elmer Maggi. . . . Students showed up in large numbers, swelling the attendance to an unexpected 1,500. Their special program featured a contest with prizes for the best technical papers and a talk by Howard Pyle, of the National Safety Council, on "The Engineer and Accident Prevention."

▶ ▶ Green and growing Phoenix was impressed on the visitor wherever water could be channeled or pumped. Engineers who had been in Phoenix for the previous Convention, in 1947, were especially surprised by its growth, seen in all directions in tours of the area -- to such diverse destinations as a steam power plant, the water treatment plant, and the Salt River irrigation facilities.

▶ ▶ For the fortunate 150 who could go, the Glen Canyon-Grand Canyon trip was the Convention highlight. All have high praise for the scenery, the accommodations, and the smooth-running itinerary at Glen Canyon, arranged by Bureau of Reclamation and Merritt-Chapman and Scott (the contractor) personnel. The Park Service cooperated, too, with a movie on the five geologic ages of the canyons. Most enthusiastic were comments on the Dons and Doñas, an Arizona organization of boosters. Two couples, dressed in costumes of the old Southwest, accompanied each of the four buses, enhancing the canyons' tour with the history and lore of the countryside and making sure that the practical side of the trip went as planned.

▶ ▶ Drums for highways. . . . The Society has endorsed National Highway Week, May 21-27, proclaimed by President Kennedy to underscore the importance of highways in the nation's transportation and traffic picture. ASCE Local Sections are urged to take whatever action they can in their own areas.

▶ ▶ A free technical library. . . . Omitted from "The Younger Viewpoint" this month for lack of space is a helpful suggestion to young engineers that they "can obtain a sizable technical library without cost by answering company advertisements and items in the Equipment, Materials and Methods and Literature Available sections of Civil Engineering and other professional journals. . . . Companies and industrial associations have both technical and non-technical publications available to the young engineer [and others not so young] on request." But ask only for material you expect to use soon -- and mention Civil Engineering when you write; it's helpful to your magazine.

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WHAT IT IS The sum of one thousand dollars is awarded annually for the original paper which is adjudged the most valuable contribution in advancing the field of foundation engineering, as related to foundations for structures.* The previous awards: *A New Technique for Stabilizing Compressible Soils, by Martin S. Kapp, Engineer, Port of New York Authority, New York City (1958); Lateral Stability of A Flexible Pier, by M. T. Davisson, Instructor, University of Illinois, Urbana, Ill. (1959); Pile Heave and Redriving, by Earle J. Klohn, Engineer, Ripley and Associates, Vancouver, B.C. (1960).*

WHO MAY ENTER Construction and other practicing civil engineers, engineering faculty, graduate students, and undergraduates are eligible.

THE JUDGES The judges for this year's competition are: Frank A. Marston, Partner, Metcalf & Eddy, Consulting Engineers, Boston, Mass.; William W. Moore, Partner, Dames and Moore, Consulting Engineers, San Francisco, Calif.; Jorj O. Osterberg, Professor of Civil Engineering, Northwestern University, Evanston, Ill.

A MESSAGE FOR ENGINEERS "In order to be well prepared for his professional duties the young engineer should be thoroughly familiar with the present status of our theoretical knowledge in the field of foundation engineering, but it is equally important that he should be aware of the limitations of theory and the need for reducing the width of the gaps in our knowledge of the empirical aspects of the subject by conscientious observations in the field. In my opinion the Alfred A. Raymond Award is eminently suited to encourage such a mental attitude and to cultivate the precious gift of intellectual curiosity."

–K. Terzaghi

For copy of the rules and regulations, write Alfred A. Raymond Award, Dept. C-3, Room 1412, 140 Cedar Street, New York 6, N.Y.

*Entry of manuscript does not preclude subsequent publication.

The Alfred A. Raymond Award competition is sponsored by the Raymond Concrete Pile Division of Raymond International Inc.

do you know that

The successful Mohole operation is a major engineering feat? The drilling ship, working in 12,600 ft of Pacific water off Mexico, has succeeded in obtaining basalt cores from under the ocean bottom, 560 ft below sediment and clays. Engineers are interested in the specially developed mooring system (consisting of motors at each corner of the drilling ship), which kept the vessel from moving more than a few hundred feet from its intended surface position, despite high winds and waves. Cooperating in the project are the National Academy of Sciences and National Science Foundation.

▪ ▪ ▪

Steel output in March was the highest since last June? March production, at 7,085,000 tons, showed a 13.6 percent increase over February. Total production for the first quarter of this year was 19,740,102 tons. Figures are from the American Iron and Steel Institute.

▪ ▪ ▪

The U. S. needs to spend $2 billion on new sewage treatment facilities? Some 5,200 new plants are required to treat municipal waste now being discharged into the nation's waters from a population of about 42 million. The annual price tag for these facilities, plus plant upkeep, is put at $600 million. Estimates are based on a recent survey of national needs conducted by the U. S. Public Health Service.

▪ ▪ ▪

Orders lowering Upper Mississippi River bridge clearances have been rescinded? Efforts of the Corps of Engineers to lower vertical clearances from 63 to 45 ft are currently in abeyance, pending Congressional action. The Corps estimated that the change would save an estimated $7.3 million on construction costs of some 23 upstream bridges. However, the protests of waterways operators prevailed.

▪ ▪ ▪

Russia has over 2,000 full-time and 20,000 part-time employees translating technical articles from the outside world? The result is that translations and abstracts are ready for Russian scientists from four to six months after initial publication. Our best counterpart system has only 1,700 part-time translators, and it takes a year to get foreign articles ready for scientific study. Authority for this is Gen. James M. Gavin, quoted by Arthur D. Little, Industrial Research Consultants.

▪ ▪ ▪

In 1940 the U. S. had only 100 airports with average runway length of 3,500 ft? Today there are 721 airports with average runway length of 6,000 ft. For use of jets, minimum lengths must be from 9,000 to 10,000 ft. Last year, for the first time, scheduled airlines carried more intercity passengers than railroads and bus lines combined. These assorted facts were mentioned by Reginald J. Sutherland, director of facilities-engineering for American Airlines, in the featured talk at a recent meeting of the Lehigh Valley Section.

▪ ▪ ▪

State engineering departments will soon be taking over some of the control of radioactive materials? Under revisions of the Atomic Energy Act, approved by Congress last year, they are to exercise regulatory control in matters of storing, transporting, and disposal. To aid the takeover, the AEC has sent state governors a set of approved criteria and a model state law.

▪ ▪ ▪

The U. S. Patent Office celebrates its 125th anniversary this year? A bureau of the Department of Commerce, the Office has issued almost 3,000,000 patents in its long history. Every work day the Office receives more than 300 new applications for patents, and every Tuesday it issues about 1,000. The importance of issuing patents to protect inventors and to encourage inventiveness was recognized by President Washington in 1790 when he signed a bill laying the foundations of the modern American patent system. Though the present Patent Office was not established until 1836, the Congressional provision of 1790 affirmed for the first time in history the right of the inventor to profit from his invention. For this our thanks to the April issue of the "Kaiser Builder."

▪ ▪ ▪

Oceanography is a promising field? According to the University of Michigan, at least 500 jobs in oceanography are going begging in the U. S., and there are only a baker's dozen schools to fill them. It is the consensus of experts that at least twice the present work force of marine scientists (about 1,500) will be needed in the next ten years. With the vast water resources of the Great Lakes as background, the university will launch a new graduate program in oceanography this fall.

▪ ▪ ▪

This is the 110th anniversary of World's Fairs? The British began the custom in 1851 with the Crystal Palace. Since then there have been some thirty World's Fairs of first rank, with half of them hosted by either France or the United States. Most successful, from a financial standpoint, was the Brussels Fair of 1958, which drew forty million paid admissions. Coming up next are Seattle's Century 21 Exposition, set for the summer of 1962, and the New York World's Fair of 1964-65. Credit for these data on fairs goes to the March issue of "General Motors World."

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Education and the profession

GLENN W. HOLCOMB, President, ASCE

From the President's Annual Address at the ASCE Phoenix Convention

Since World War II, a multitude of new discoveries in science, the problems of defense, and the need for research for the space age have brought startling changes in the civil engineering field. We have moved forward at an accelerated rate with each decade that has passed. This rapid acquisition of knowledge has inevitably brought new ideas in education.

In the past five years particularly, engineering education has undergone changes as a result of the 1954 report of a committee of the American Society of Engineering Education entitled "An Evaluation of Engineering Education." This report recommended substantial changes in the content of curricula in the engineering schools of the country and its recommendations have been used by the Accreditation Committees of the Engineering Council for Professional Development (ECPD) in the accreditation of engineering schools. There has been measurable resistance from civil engineering departments and from practicing civil engineers who have questioned the advisability of quite so extreme a revision of curricula as ECPD has recommended.

Conflicting educational aims

Next came the work of an ASCE Task Committee on Civil Engineering Education, followed by an Opinion Research Council report, which did not, in the final analysis, bring a satisfactory answer. Then, through the efforts of Cooper Union acting as the coordinating agent, supported by ASCE, a grant of $40,000 was obtained from the National Science Foundation to finance last summer's Conference on Civil Engineering Education at Ann Arbor, Mich.*

At the conference there was honest confusion and misunderstanding caused by lack of time to review and analyze all the reports presented. At the same time there was the feeling on the part of all present that there is an urgent need to decide on the direction engineering education is to take in future.

To decide this question a ballot has been mailed to all the engineering schools represented at the conference. Two copies of the ballot went to each school—one to its official representative at the conference and one to the civil engineering department. Each ballot was accompanied by the volume recently published by ASCE under the National Science Foundation grant, entitled *Civil Engineering Education*. It contains the proceedings of the conference and all the papers there presented. Each institution is expected to make a most careful appraisal of the ballot as well as of the accompanying papers before returning the ballot, for the decision of these ballots may well have a lasting effect on the prestige of the civil engineering profession. The decision on this matter may well be the most important step the profession will take this year.

Now it seems necessary to review the steps by which this controversy on civil engineering education reached its present high pitch. The 1954 report of the ASCE Committee on the Evaluation of Engineering Education included all engineering. Perhaps it was a misunderstanding or misinterpretation by some that led to lack of support for it by many in civil engineering professional practice.

The report was comprehensive and profound in its conclusions and recommendations. It called for increased hours in science and mathematics and a stepping-up of the contents of the courses. This pointed to the need for more intensive study at the secondary school level. The name "engineering science" was applied to a series of existing courses used to relate science to engineering. This term now includes such courses as those formerly called "strength of materials," "fluid mechanics," and "dynamics." The increase in the required credits in these courses makes necessary a radical change of subject matter for most schools since many of the required credits are not specifically related to civil engineering. The stated aim of the new curriculum is to give broader training in all fields of "engineering science."

Raised standards and reduced enrollment

Since this curricula requires the student who takes a four-year course to be ready for calculus when he starts college, it will probably cause a decrease in the number of entering students as many will not be able to meet this prerequisite. Those institutions with very selective entrance require-

* Reported in CIVIL ENGINEERING by William P. Kimball and Cornelius Wandmacher, Jan. 1961, pp. 56-59. The volume,, *Civil Engineering Education*, containing conference proceedings and papers, is available at $1.00 from ASCE headquarters in New York, N. Y.

ments will not be particularly affected since they are enrolling students of near-genius ability who are so much needed in the research areas of our profession today.

There is no quarrel with the report in so far as it relates to students of high ability who are to be prepared for advanced work at the graduate level —about 20 percent of the total student body. But I believe it has overlooked 80 percent of the present enrollment. These students, while not of genius ability, do have the capacity to perform those professional jobs that so many engineers are doing today.

The question we must answer is: Do we want the engineering profession in the future to consist of fewer members than in the past? The proposed curricula will cause a high mortality in schools that do not have very selective entrance requirements, that is, in most of the schools, unless there is considerable watering down of the content in the prescribed science and mathematics courses. The only thing that will prevent the high mortality rate will be higher entrance requirements, which again will lower enrollment.

We must remember that in the history of mankind great things have been achieved by men whose minds, instead of being highly scientific, were intensely practical. Many worthwhile things have been done by such minds. I do not mean to infer that scientific training is not good. We must not slacken our pace in training for systematic scientific thinking, for we will never have enough of such people.

Each graduating class of civil engineers contains about 40 percent of those who entered as freshmen. The mortality rate is high, or, to state it another way, the graduate of any engineering school, even though he may be at the bottom of his class, still has considerable ability. Both he and the man at the top of his class have good opportunities in the profession since many qualities other than academic grades lead to success in later life in civil engineering as in other fields.

There still remains the questions, How many graduates do we want? Need they be all of one quality? At the present time and under present standards, we can expect about the same number of engineering graduates as in the past. Enrollments have been decreasing in the past few years but are expected to increase again in the years ahead. If the standards for courses at the freshman and sophomore levels are maintained at the target set, it may be expected that the mortality rate of entering students will be much higher than in the past. Also, since many of the motivation and interest-generating subjects will be eliminated, more students may be expected to drop out through lack of interest.

Average students neglected

The new curricula will leave fewer graduates than we have had in the past, but the quality may be better. More of these men may be expected to go on to advanced degrees and research, further depleting the number available for the normal civil engineering work of today. At present no special consideration is given to the needs of those in the lower brackets of the graduating classes. This situation may seriously affect the amount of engineering talent that will be available at the normal level.

This deficiency could be corrected by providing less rigorous curricula in the first two years, allowing the student time to adjust to the academic program and at the same time providing him with some interest subjects in his chosen field. After all, engineering is applied science. The earlier the student becomes familiar with some of the applications, the sooner that all-important part of the learning process—interest—will be aroused. Nothing is more deadening to the interest of most engineering students than hour after hour of theoretical basic science, with no opportunity to consider possible applications. If it is not deadening to them, then they probably should be enrolled in some strictly scientific field rather than in engineering.

Two objectives are evident in the philosophy of engineering education today: training for research and training for the practice of civil engineering. Each differs considerably from the other both in its objectives and in the disciplines required for successful accomplishment.

At present only those who show evidence of considerable academic ability in their undergraduate years are permitted to move on into graduate work. In most students this type of ability is clearly shown by the end of the sophomore year. Much financial aid in the form of scholarships, fellowships and assistantships is available for these students so that the cream of the graduating seniors are enabled to pursue advanced study.

A suggested solution

It would seem logical to me to go a little further and locate those students who have a flair for research and definitely point their training in that direction. This could be done without the stigma of segregation that sometimes shows up in the honor classes of the present system. For those who have maintained a predetermined grade average the first two years, a special course in research engineering could be open at the beginning of the junior year. For this course there would be special prerequisites beyond those required of other students.

Those students not following the research program would continue with a program not containing so much science and mathematics. These students comprise about 80 to 85 percent of the present enrollment in the engineering schools. In this program, all students during the first two years of their college course would carry a normal load of mathematics and science—not one overloaded with them. This would leave room for a study of those normal tools of the civil engineer about which he is expected to have a working knowledge. I refer to drawing, surveying, and materials laboratory work, for example. Such courses will motivate the student and will not discourage him.

In their third and fourth years, the larger group of average students should continue in curricula designed to teach them the application of science to the practical problems of the engineer. This means any problem that may be expected to develop in work that can be related to the fields of the fourteen Technical Divisions of ASCE. Some claim that this cheapens the profession of civil engineering but I do not think so.

It is in line with the educational objectives so well outlined by the late Prof. Daniel W. Mead, a Past-President and Honorary Member of ASCE, who said:

"The purpose of technical education is not so much to impart technical knowledge to the student as to furnish the training which will enable him to think clearly and accurately, to understand and investigate the conditions which surround the problem, to determine the fundamental principles upon which its successful solution depends, to ascertain and analyze the elements which influence or modify it, to design the structures and works needed for its successful development, to supervise the proper construction of such structures or works, and to carry them to the consummation of a successful and economical completion."

This purpose, as stated, if carried to a successful conclusion would in the year 1961 give us graduate civil engineers satisfactorily trained to start work in the civil engineering field in this atomic age.

Not all our young men can be accepted for graduate work nor does the

doctor's degree mean that he who holds it is a better citizen or professional engineer than he who does not. It does mean that he has qualified to do a certain type of work in a certain specialized field and may be able to demand a higher salary than some others. However, many professional engineers demand salaries far higher than others who have a PhD.

All these men are needed in the civil engineering profession. We should not lose any of them by stiffening course requirements to the point where most will have to withdraw and turn to other fields. There is evidence that educators have neglected the inspirational approach which is needed to stimulate students to extend themselves in the quest for knowledge.

It seems reasonable that ability to do work which requires a knowledge of technical science would be classed above all other abilities. Also, the engineer with knowledge and experience in his field should be the one to supervise both the young technically trained engineer and others with duties of a subtechnical nature. We do not want to develop men or professional organizations that desire to thrive on the ability of subordinate engineers. We should have the right to expect that all the professional organizations, and educational institutions, will develop and educate their engineers to have the expectation of further enhancing their position through professional attainments and knowledge and not through purely business methods.

The rudiments of practice should be started early for this is the area in which professional standards and ethics can be most effectively impressed on a young man. It takes cautious instruction, reading, illustration, and contacts with professional engineers over the college years to get the roots of it started by the time of graduation. Such contacts and ideals properly encouraged during the undergraduate years will send the young man into the profession with an attitude that will make him continue to grow professionally throughout his career.

Later technical growth

To help the young engineer, and all engineers, continue to grow in technical knowledge and understanding ASCE provides many valuable aids. To me, one of the inspiring aspects of serving as an officer of the Society has been the opportunity to become better acquainted with the wide variety of technical activities carried on by members and groups of members. I refer to the work of the Technical Divisions, in which I fear too few of the membership actually participate. Yet more than 1,500 members are serving on approximately 300 committees representing the 14 Technical Divisions and including joint activities in cooperation with some 20 other societies and associations.

Some very interesting things are happening within this area of Society effort. To single out for mention any one such effort is hazardous but I want to mention a few. There is the Committee on Electronic Computation, which has attracted over 50 specially trained men to a variety of assignments. Another example is the industry-oriented committee of the Pipeline Division, which is studying the knotty problem of pipeline crossings of railroads and highways. An entirely different type of activity is that of the Surveying and Mapping Division committee which produced the splendid study of the status of the engineer in surveying and mapping. A prerogative of the President is to recognize such accomplishments and hold them up as examples to be emulated.

Fewer committees and better committees

With so many committees, it is to be expected that some will make more progress than others. But must we be satisfied to continue in operation those committees which persistently show lack of accomplishment? I would like to charge our administrative committees to nudge such committees into more productive patterns, or to find new people to carry out assignments felt to be deserving of energetic attention.

I would like to draw another murky picture for your consideration. We have so many meetings and conferences and conventions, conducted by this and other organizations! Many of these activities have become conflicting, competing for attention, time and credit. This proliferation is not a credit to a profession which is dedicated to creating things that are better and simpler and more economical. Our Society has made progress in cooperation and consolidation of interests. We should work unceasingly to persuade other organizations to match this effort. Fewer committees and better committees, fewer meetings and better meetings, should be our goal.

There is also the field of research which calls for our attention. While it is only recently that our profession has come to take an active interest in research, rapid strides have already been made. Only a year old is the provision for research councils in the structure of ASCE. Newest of these councils is that devoted to Air Resources Research, a product of the Sanitary Engineering Division's Committee on Atmospheric Pollution Abatement. Many other fields of research in civil engineering could profit from this type of organization, stimulation, and guidance.

Keeping abreast of new developments

An essential to the advancement of engineering techniques is the free outlet of ideas in publications. Our Society has gained leadership and stature through the volume and quality of its publications. This effort is very costly but we must maintain and expand our capacity to print and circulate engineering knowledge. We have ever before us the challenge to find ways to express more ideas with fewer words and fewer pages and fewer volumes.

Where can our members find a means for keeping abreast of technological advances except in this department of technical activities? Attend the technical sessions at the national meetings; attend the conferences of the Divisions in your field; read the publications of the Society and participate in the discussions. It is your Society; help to make it a better society.

Of equal stature with the Technical Divisions are the committees of the Department of Conditions of Practice. The men who give their time on these committees have many difficult, perplexing problems to solve, and sometimes disagreeable duties to perform, but they do them unstintingly for the welfare and prestige of the Society. I wish to commend them and thank them for their devoted service.

Many of the objectives of the Department of Conditions of Practice are oriented to the professional performance of the engineer. Therefore we should expect that through these committees a special effort would be made to imbue the younger engineers with the professional attitude. We recognize that the professional engineer performs a service for his client, whether that client is an individual, a private group, a company, or a governmental organization. Likewise, the engineer in the performance of his professional duties must have a close relationship with his client so that he will understand the client's needs. To provide the desired engineering services he must also deal with material things which he is planning to use as efficiently and economically as possible for the benefit of his client.

The engineer must combine a thorough knowledge in his field of service with high ethical and professional standards, which will at all times control his actions in the best interests of his client. In other words, the mastery of technical knowledge is by no means the only aim of a professional society.

Another piece of equipment of the professional engineer has not yet been mentioned; it is experience, which can only be acquired with time. Thus the professional engineer gains in stature as his experience grows in parallel with his development in other areas.

The client who employs the engineer must be able to accept his work and counsel with full confidence that he is obtaining reliable information on the problem at hand. While the client is his first concern, the engineer must also keep in mind the general public, which in many cases may be affected. He must also keep in mind the attitude of the members of the engineering profession. In providing professional services the engineer must at all times seek to give the best possible value to the client while also assuring protection to all who may be affected.

The engineer often has to make decisions that are outside the area of mere technical knowledge but may affect his own monetary gain. All such factors must be carefully and honestly evaluated to make certain that all values have been honestly appraised. The true index of the professional attitude in the final analysis is service without direct personal benefit. Here is the area of the profession which deserves the best support that each can give, also his best thought that our profession may continue to flourish.

Our profession requires not only knowledge but those larger qualities that fit the individual to live and conduct himself as a professional man in his own community. And of course the strength of the profession always depends on the young people who come into it each year.

It is the latter who should engage our most earnest attention, at this time when changes in our engineering educational system are threatening to disrupt the whole purpose of that education. This problem of training our young people, who must follow us and who must be equipped to meet the growing challenges of the world, cannot go unsolved if we are to produce sufficient talent to keep building a still better world.

Faculties of our engineering schools must keep in mind the fact that the vast majority of the students intend to become practicing engineers, and curricula must be adjusted to meet the continuing demand for such engineers.

I might even go so far as to recommend that it would be advisable for teachers to arm themselves with practical engineering experience before attempting to train students who intend to become practicing engineers. At least, proper credit should be given those teachers with practical experience.

Lift-bridge replaced under traffic

ARTHUR A. COLLARD, F. ASCE

Project Engineer, Tippetts-Abbett-McCarthy-Stratton, New York, N. Y.

Just about the reverse of the usual procedure is being followed in replacing an obsolete swing span with a lift span at the Broadway crossing of the Harlem River Ship Canal in New York City. The swing span was floated out and the new lift span floated in. Now the approaches and lift towers are being erected by derricks set on the lift span.

The old bridge carried three lanes of highway traffic on its lower deck and three lines of a New York subway on its upper deck. The new structure will have six highway lanes and will continue to carry the subway. Rapid shifting was mandatory to keep to a minimum the time the subway, operating in this area on an elevated structure, would be out of service. The change was made in 72 hours on Dec. 23 to 26, 1960.

The erection procedure for the end spans and towers is practical because a 25-ft clearance is provided under the lift span in its down position. During construction larger ships can detour by going around the lower tip of Manhattan. The old bridge was opened 74 times in its last year of operation.

The swing span, built in 1905, was 270 ft long and had two riveted trusses spaced 39 ft apart. This span, weighing about 1,500 tons, was supported at its midpoint by the main or pivot pier, located near the center of the canal. When the swing span was in closed position, its ends rested on two smaller piers located about 50 ft outshore from the bulkhead lines, Fig. 1.

New bridge

The new structure, Fig. 2, is a three-span, double-deck, vertical-lift bridge consisting of a main lift span, 304 ft between bearings, flanked at each end by a tower span. The lift span has two Warren-type trusses spaced 80 ft on centers, and a total weight of 2,500 tons, making it one of the heaviest structures of its kind. The normal full opening of the lift span is 111 ft above the seated position at 25 ft above mean high water, giving a total clearance of 136 ft. The operating machinery is designed to raise or lower the span through 111 ft in 1½ min with a wind load of 2.5 psf on the exposed area.

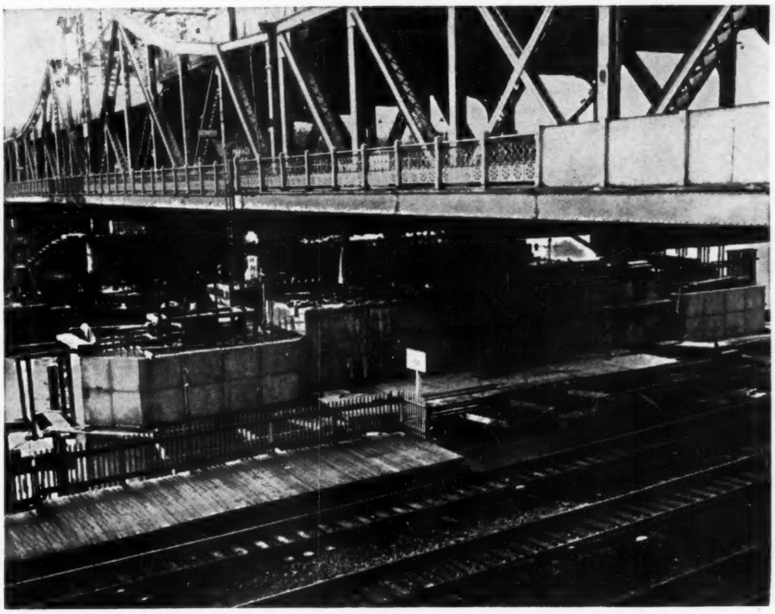
The vertical-lift bridge eliminates the need for a center pier and provides a 288-ft clear channel width—compared to two 101-ft channels for the swing bridge. Location on a sharp curve of the channel makes this change especially desirable. Because the new span is longer, the needed piers could be built between the old intermediate piers and the abutment—outside the channel. Piers were founded on rock at moderate depth. Putting the new bridge on the old alignment keeps to a minimum the changes required in both the subway and highway approaches. It is possible also to support the rear legs of the tower and the landward ends of the approach spans on extensions of the existing abutments.

North-bound and south-bound roadways are each 34 ft wide—two 11-ft lanes and a 12-ft truck lane—with the roadways separated by a 4-ft center mall. Sidewalks, at road level, are cantilevered outside the trusses. Highway loading is H20-S16 for heavy tractor trucks with semi-trailers. Rapid-transit loading is that specified by the New York Transit Authority for cars of the Independent and BMT type.

The pertinent specifications for highway and movable bridges of the American Association of State Highway

Officials, and similar data for railroad and movable bridges of the American Railway Engineering Association, were used in designing the bridge, appropriately modified to include certain specifications of the Transit Authority. Although a 50-percent increase in normal allowable stresses was permitted for erection purposes, the size of a number of the members in the lift-span trusses was governed by the erection stresses. Some of the members of the short approach or tower spans also must be made heavier to meet erection stresses.

All members of the two main trusses are fabricated of silicon steel with the exception of the diagonal at mid-span, which is made of carbon steel. Silicon steel is also used for the floor beams of both the railroad and the highway decks and for the lifting girder at each end of the span. All other structural members in the main span, including floor stringers, lateral bracing, diaphragms, brackets, railing and roadway grating are of carbon steel.



Construction of new piers proceeds while old swing span is still in place. New York Central Railroad tracks, and the need to maintain the existing elevation of the subway tracks, made vertical clearance a problem for the new lift bridge.

Vertical clearance a problem

Special conditions, especially height limitations, affected the design of the structure. Four main-line tracks of the New York Central Railroad pass beneath the north tower and approach to the new structure and require an 18-ft clearance above top of rail. Minimum vertical clearance over roadways on the new bridge is 14 ft, and only 18.8 ft is available from the roadway surface to the top of the subway rail. To meet this limitation and to provide a vertical clearance of 14 ft for the roadway on the lower deck, it was necessary to provide a floor system for the upper deck with a depth not greater than 4.8 ft. This was achieved by supporting the upper floor beams at their quarter points by hangers suspended from the sway frames over the upper deck, which provide lateral stiffness in the vertical plane of the cross section of the bridge. By limiting the effective

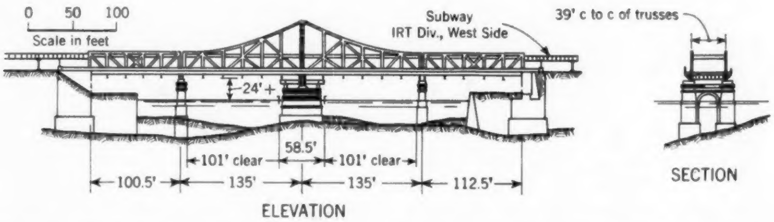


FIG. 1. Original swing span, built in 1905, was supported on central pivot pier, providing two 101-ft clear spans.

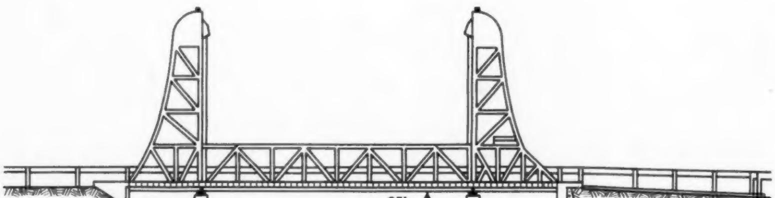


FIG. 2. New lift span provides clear channel width of 288 ft. At normal full opening, vertical clearance is 136 ft.

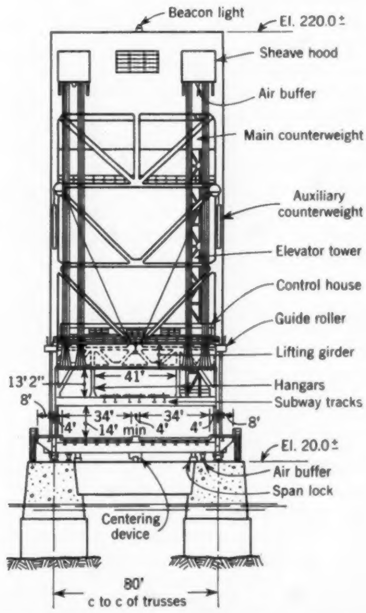


FIG. 3. Elevation of tower shows hangers supporting the upper floor beams at their quarter points. The hangers are suspended from the sway frames at the top chord over the subway deck.

Lift span is moved on barges to bridge site. Swing span has already been floated away. Careful scheduling and coordination permitted early resumption of subway traffic.

span length of the beams for rail support, their depth could be held to an acceptable amount.

The towers, Fig. 3, are 200 ft in height from the pier tops; they span between the abutment and the pier at each end of the bridge. The span at the north tower is 94.5 ft between bearings, and that at the south tower is 81.0 ft. The towers are fabricated chiefly of carbon steel, only the floorbeams in the railroad deck being of silicon steel.

To meet the requirements for vertical clearance over the tracks of the New York Central Railroad, a special shallow-depth highway deck is provided in the north tower. This deck consists of closely spaced rolled-steel floorbeams covered by a reinforced-concrete deck slab, anchored securely to the top flanges of the floorbeams by means of shear connectors and acting integrally with these beams. To add strength and stiffness to the shallow floorbeams, a heavy steel coverplate is welded to their bottom flanges.

Floor system

The sidewalks for the tower spans and the lift span are designed to carry the standard AASHO sidewalk loading. Borden-type grating 1½ in. deep, with a rust-resistant steel plate ⅛ in. thick welded to the under side, is used. The grating is filled with a 1:3 cement mortar to provide a smooth walking surface.

The roadway of the lift span is designed as a floor beam, a stringer and a Borden-type open-grating floor 5 in. deep, meeting AASHO H20-S16 loading requirements. The roadways of the tower spans have floor beams, stringers and a reinforced concrete floor. The subway deck has 8 x 8-in. wood ties under the rails. Stringers, which frame into the floor beams, are placed under each of the six rails.

Lateral and sway bracing

Three lateral systems of bracing are provided: (1) a lower system in the plane of the bottom chords of the trusses of the lift spans; (2) a system in the plane of the lower flanges of the stringers supporting the IRT tracks (with the traction trusses, which resist the braking action of the IRT trains, also in this plane); and (3) a top system in the plane of the top chord of the trusses of the lift span. Each of these three lateral systems was designed as a simple-span truss, one each for the tower and the lift span.

The traction trusses were designed independently according to the loading specified in the AREA specifications for electric railway cars. The end diagonals are fabricated short so that an initial stress of 15,000 lb is obtained during erection. Nominal sway bracing is provided in the plane of all the vertical posts on the towers and lift span.

Mechanical and electrical equipment

The moving span is balanced by counterweights, suspended by ninety-six 2½-in. wire ropes of improved plow steel, passing over 8 sheaves at the tops of the towers. Two sheaves, 15 ft in pitch diameter and carrying 12 ropes each, support each corner of the lift span. The ropes are attached to two lifting girders at the ends of the lift span. Links are provided in each tower from which the counterweight can be suspended during construction, replacement of ropes, or other emergency. The end floorbeams are designed to take the stress of jacking the weight of the span.

The main counterweights are of concrete in steel boxes. The shifting load of the main counterweight ropes is compensated for by means of auxiliary counterweights on the front of the towers, supported by wire ropes that pass over sheaves at the mid-tower height and thence to connections on the lifting girder.

While the lift span is being raised or lowered, it is held in position by guide rollers, which engage guide flanges on the lower columns. It is guided transversely at the four upper and four lower corners, and longitudinally at the two lower corners at one end only. The main counterweights are similarly guided by shoes, which engage guide angles mounted on the longitudinal tower bracing. When the span is seated, it is centered transversely by centering devices under the end floorbeams.

Four double air-buffers are provided under the end floorbeams to relieve shock when the span is being seated, and there are four similar buffers at the tops of the towers to stop overtravel of the span. Locks are provided for holding the span in the closed position, and rail locks to insure that the track rails of the IRT system are fully seated.

The span is operated by electric motors in the tops of the towers, geared to the 8 main sheaves. For normal operation, two d-c motors, each rated at 500 hp, are supplied by two motor-generator sets of 500-hp capacity, one in each tower, equipped with amplidyne controls to keep the two motors in step, thus insuring that the span will remain level at all times. Two separate 2,300-v lines are carried to each end of the bridge by the local public utility.

For emergency operation, there are two 500-hp d-c motors, similarly connected to the operating machinery and supplied by motor-generator sets of 125-hp capacity, equipped with self-leveling amplidyne control. Complete control equipment and electric brakes are provided to govern the movement of the span, the equipment for the normal motors being independent of that for the emergency motors. The emergency motors will operate at one quarter the speed of the normal motors.

The sheaves, gearing, motors, motor-generator sets, and other equip-

ment at the tops of the towers are enclosed in the machinery houses, while the control equipment and control desk are in a house above the IRT tracks in the north tower. The control house is provided with various catwalks to permit the bridge operator a proper view of river traffic. However, gate-tenders will also be needed to control traffic on the vehicular level, because the view of the roadway from the control house will be obstructed by the railway deck. There are two gateman's shelters, one at each end of the bridge.

There are warning and barrier gates for the highway deck at each end of the bridge and a system of traffic lights and warning signals for IRT, highway and river traffic. The bridge control is interlocked with the IRT signal system in order to provide proper safety in railway operation. Provisions have been made for supplying electric power to the third-rail system of the IRT on the lift span.

Lift span is seen in place before construction of towers. Subway traffic is maintained while the tower spans are erected.

Erection procedure

The plan for construction was predicated on erecting the lift span elsewhere, floating it into place quickly, and restoring rail traffic. Now that this part of the work has been completed, the towers can be erected without undue haste, using derricks placed on the end bents of the lift span. The existing truss spans near shore will be removed as a unit and the deck for the rails at the towers erected as a unit. This method requires neither rail crossovers at the site nor temporary platforms for passengers. It requires only three week-end closings of the subway.

Stage A. Construction of the new river piers was completed under Contract No. 1 early in 1960. This was followed by the erection of the lift span on barges near the site, at an elevation suitable for low-level floating in. For clearance, sidewalk and expansion-joint projections beyond the truss end-post were omitted; subway track was erected, omitting end sections to permit adjustment for closure with the track of the existing approach spans after floating in.

Stage B. While maintaining roadway and rail traffic, connections at the first interior approach truss panel points were made for the transfer of reactions to the new piers. With the roadway traffic stopped and the subway traffic maintained, concrete slab, buckle plates, stringers and steel curbs, and the projection at the end floor beam were removed.

Stage C. With roadway and rail traffic stopped for the first 72-hour period, the hinged track sections between approach and lift spans were removed. The swing span was lifted on barges and floated out. Reactions of the approach spans were transferred from the existing to the new piers and the end panels of the existing approach spans removed. The new lift span was floated in and placed in position on the new piers. At the rail deck, a temporary track closure was provided between the new lift span and the existing approach spans, and subway traffic was resumed. Temporary road closure was provided between the new lift-span and the existing approach spans so that the deck was continuous. This work was completed early in 1961, under Contract No. 2.

Stage D. With roadway and rail traffic maintained, new abutments and wing walls are being built. Using erection derricks on the end posts of the lift-span, the tower trusses will be constructed up to a point a little above the top of the lift span. Vertical sway frames at the front portal and interior points U_1 and U_2 will be erected, omitting track floor-beams and leaving the tension columns to carry the rail deck hanging in position. Transverse bracing struts at the rear tower legs, including diagonals, will be erected. Then rail traffic will be stopped for a second time. The existing approach spans, trusses and decks will be demolished and the new rail deck and floor beams at the roadway deck erected. Subway traffic will then be resumed.

Stage E. With rail traffic maintained and roadway traffic stopped, the roadway and sidewalk framing will be completed, the concrete roadway slab will be placed and the sidewalk gratings filled with mortar. Then with IRT and roadway traffic maintained, the erection of the towers will be completed and all machinery installed. Finally, the three existing river piers will be demolished, rail and roadway traffic stopping only at blasts. It is anticipated that this work under Contract No. 3 will be completed by the end of 1962.

With the cooperation of the Borough of Manhattan, the New York City Transit Authority, and the New York Central Railroad, the work is being done by the New York City Department of Public Works. The project was under the direction of the late Frederick H. Zurmuhlen, F. ASCE, Commissioner of Public Works, City of New York. Under Samuel Cooper, Director of the Bureau of Bridges, construction supervision is the responsibility of E. Backus, chief of the Bureau of Bridge Construction. Design was handled by Tippets-Abbett-McCarthy and Stratton, consulting engineers.

- **Contract No. 1,** erection of the new piers, was completed early in 1960 by Moore Lopier, Inc., of New York, N. Y.
- **Contract No. 2,** for the lift span, was completed early in 1961 by the American Bridge Division of United States Steel.
- **Contract No. 3,** for the abutments, towers and approaches, was awarded to Slattery Contracting Co., Inc., late in 1960. It is anticipated that this work will be completed by the end of 1962.

Glued laminated timber frame for a crane building

BENNETT W. BURNS, F. ASCE, Consulting Engineer, Houston, Tex.

Timber was the material chosen by an Arkansas lumber company for its new rough dry-storage building, which has a length of 468 ft and houses a high-speed crane of 10-ton capacity to handle rough lumber in and out of storage. The crane operates at a height of 41 ft 6 in. above the floor, spans 100 ft, weighs 135,000 lb and travels at 600 fpm. Storage requirements of 4 million fbm fixed the length of the building. Provision is made for extending this length to 1,100 ft and for a second crane, to store 12 million fbm.

Crossett Lumber Company, a Division of the Crossett Company of Crossett, Ark., retained the firm of H. E. Bovay, Jr., consulting engineers, with whom the writer was associated as partner, to develop a master plan for stepwise plant modernization. The rough dry-storage building forms a significant part of the improvements recommended and adopted.

It has been the policy of the Bovay organization to compare wood construction with steel in all cases. Improvements in wood technology as well as in gluing, fabrication and erection techniques in the past few years have made wood much more competitive with steel. With few exceptions, however, buildings of this size and type have been constructed of steel. But since this building was to be used in the lumber industry, and wood construction appeared to be competitive in price, wood was considered along with steel for the structural components. Progress in the art of laminating wood for large structures and certain other advantages showed that Crossett would benefit by selecting timber for this building.

Specifications and design criteria were prepared for both steel and wood buildings. Details of basic design were not limited in the specifications. Better bids were obtained on the structure by allowing the fabricator to use the type of construction most familiar to him as long as it satisfied the engineering requirements. All details of design and construction were subject to approval and checking by the engineering consultants. Design loadings, in addition to the crane loadings indicated in Fig. 1, were specified to be 20 psf for live loads on the roof, and 25 psf for wind load.

The building was to withstand the worst combinations of loadings as follows:

1. Dead load + live load
2. Dead load + live load + crane load
3. Dead load + wind load
4. Dead load + live load + ½ wind load
5. Dead load + wind load + ½ live load

Design, detailing and workmanship were further specified to conform to:

National Design Specifications for Stressed Grade Lumber and its Fastenings of the National Lumber Manufacturers Association

Timber Construction Standards of the American Institute of Timber Construction

American Institute of Steel Construction Specifications

Extensive experience with the design of buildings of this type shows that it is not practicable to brace the structure to withstand the impact of the mass of a loaded crane applied against the stops at or near maximum speed. To guard against such a possibility, limit switches were installed about two bays back from the crane stops. This shuts off the power, allowing the crane to stop before reaching the bumpers. The operator can override the limit switch in order to operate at reduced speed in the end bays. Also, a weak joint is provided in the crane beam, which will permit the crane's momentum to be broken without risking failure of the entire building.

When the bids of contractors using steel structural members were compared with those of the wood fabricators, it was found that the wood building was competitive with steel. Since the lumber industry would benefit from the selection of wood, it was used.

The successful bidder for the project was Unit Structures, Inc., of Peshtigo, Wis., and Magnolia, Ark. Steel crane beams were furnished and fabricated by the Mosher Steel Co. The Collie Construction Co. of Little Rock, Ark., performed all erection.

During the design period, certain features became of particular interest. It was found that fixed-base columns, which were least expensive, required special connection details for fastening the columns to the base plates. These details are shown in Fig. 2.

Bow-string trusses were used because they were the cheapest. Detailed design of the connections of the trusses to the columns and of the knee braces to the columns presented a problem because of the thickness and extent of the column section required at these locations. Details of the connections, Fig. 3, show the fabrication required for these steel connections. In the design of all these members a major problem was that the connectors were so long that eccentricity was introduced into main members.

A comparison of the cost of glued laminated material and solid sawn material led to the selection of sawn material for some members. The purlins were made up of three 2 × 12's nail-laminated together.

To insure the strength of the structure over a period of years, the columns were pressure treated after lamination with 8 lb per cu ft of pentachlorophenol.

Another feature of interest was the

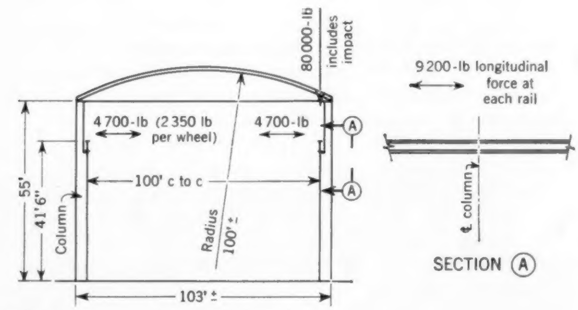
Drift pins catch one or two holes as knee brace is jockeyed into exact position before truss is raised to the top of the heavy wood columns.

Trusses were raised by truck crane, other materials being handled manually. Nominal 2-in. material is bent over the roof stringers and built-up felt roofing applied.

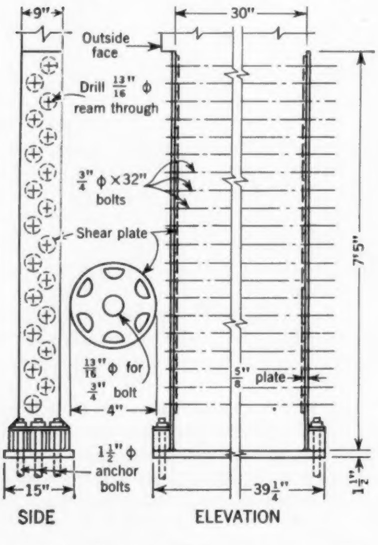
design of the crane runway beams. Intensive research revealed that there were few installations of laminated-wood crane beams for high-speed cranes with heavy wheel loads. At least one of these had experienced difficulty in maintaining the beams. Therefore, for the installation at Crossett, steel is used to eliminate this possible trouble spot. It is probable that additional experience with laminated beam construction will establish design criteria to fulfill the requirements of this operation in the future.

The roof consists of four-ply built-up roofing applied over 2-in. wood decking. Siding is corrugated sheet metal nailed to sawn timber girts. A strip of translucent plastic 8 ft wide was used near the roof to provide daylighting. Roof purlins were analyzed to resist uplift, and girt connections provided for negative pressures.

This first effort in designing a wood structure of this particular type did not result in a building significantly cheaper than a similar steel structure. It has however established the fact that wood can be used to build an entirely suitable structure for such service, including a heavy crane, at a competitive cost. It is expected that savings can be realized in future wood buildings of this type through the improvements in fabrication and erection techniques that can be effected because of the experience gained from this structure. The structure is a significant forward step in the use of wood products.



▲ FIG. 1. Crane loadings are shown diagrammatically. Maximum wheel load of crane is 46,000 lb. Maximum longitudinal crane loading for intermediate bays is given in Section A.



◀ FIG. 2. Moment connections at base of column are complex and extensive.

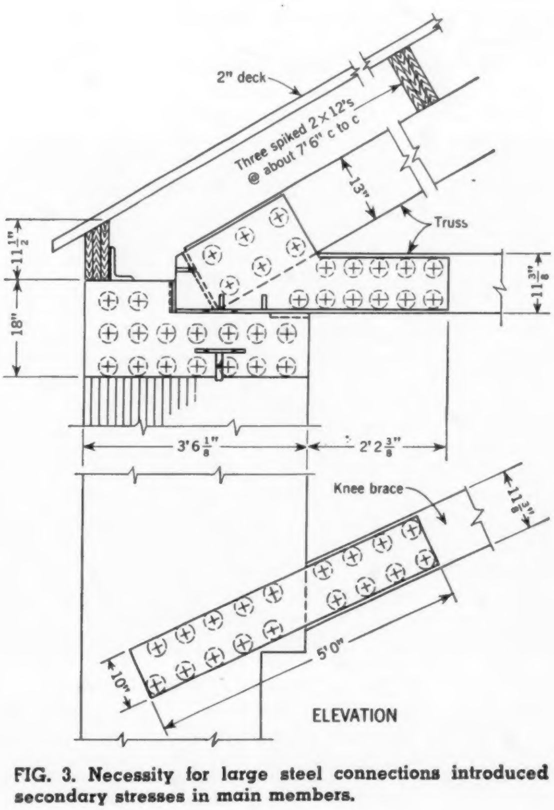


FIG. 3. Necessity for large steel connections introduced secondary stresses in main members.

Water Resources—Phoenix Convention Theme

Nearly 1,500 civil engineers and their ladies enjoyed fabulous Arizona weather and hospitality as they attended nearly fifty sessions that marked the ASCE Convention, held in Phoenix, April 10-14. Ideas ranging from advanced to, perhaps, reactionary were propounded by general meeting speakers. Water was the principal technical theme in dry and sunny Arizona, but roads for wide-open spaces and parking for congested areas got attention, too.

The Board of Direction nominated Dr. G. Brooks Earnest, president of Fenn College, Cleveland, for next President of ASCE. Election will be carried out by mail ballot during the summer. The Board selected Samuel Morris, of Los Angeles; George Richardson, of Pittsburgh; Thorndike Saville, of Gainesville, Fla.; and Abel Wolman, of Baltimore, Md., for Honorary Members of the Society. Finley Laverty, of Los Angeles, was named winner of the Professional Recognition Award.

Presidential Nominee Earnest may have outlined his platform and aims for ASCE in a paper prepared for the General Membership Luncheon long before his selection as the candidate. He advocated permitting only those who are registered to use the title "engineer." Further, he advocated rating firms as to attitude and treatment of engineers as Engineers Council for Professional Development rates curricula, using persuasion and accreditation to upgrade the profession. His talk will appear in the June issue.

President Holcomb presented ideas on civil engineering education that will be considered conservative by some educators, but seemed to meet the approval of those who heard him speak. He goes only part way on the more-math-science-and-research thinking of many educators. President Holcomb's talk is on page 33 of this issue.

Floyd E. Dominy, Commissioner of Reclamation, told a luncheon session that problems of water will require us to move further and faster than ever before—through research. To date, research has been mostly on specific design problems. Much more money and effort are needed for research of a general nature. Some money is currently available. Evaporation is one big problem, with 14,000,000 acre-ft of water lost to evaporation every year from Western reservoirs. Mr. Dominy challenged his hearers, "Plan for the future with vision and imagination, then apply the hard rules of economics and engineering to turn those dreams into reality."

Conditions of Practice sessions

As usual, there was a great deal of interest in Conditions of Practice sessions seeking to improve the status of the engineer. A panel discussion on "The Incompatibility of Unionism and Professionalism" evoked considerable discussion, including a suggestion that at such a session someone should be permitted to explain the union side of the question.

T. C. Ewbank, of Tucson, told about the growth of unions in this country to the present number of 189, about 30 of which represent technical personnel. The fact that the largest of these technical unions, the Engineers and Scientists of America, representing 25,000 persons in seven autonomous unions, dissolved last January may not have been the desirable action it was first thought. If these groups join other unions the case for professional status may have been weakened. These unions offer strong representation at the bargaining table, but many engineers do not feel that this is what they principally want. Mr. Ewbank concluded that unionization is not the solution to our problems. A problem does exist, and the way to keep unions out is solve our own problems so well that unions are unnecessary.

Philip Abrams, director of Public Works of Palm Springs, Calif., and previously active in the Los Angeles Younger Member Forum stated: "We must earn more of whatever we want from society by contributing more to society at increasing levels of excellence and abundance. Herein lies the basic incompatibility which separates unionism and professionalism . . . The degree of individual responsibility accepted by the engineer determines his practice of professionalism. Unionism and professionalism cannot exist together because of this responsibility.

"The concept of unionism for collective bargaining removes individual rights for the benefit of the group . . . These rights are: The right to produce work without limitation as to time spent doing the work or quantity of work produced—unions have been noted for their leveling influence on productivity; the right [of the employee] to choose the work he will perform and the employer or client for whom he will work—unions have consistently worked from lists of persons available in filling new positions; the

right to refrain from using force to bargain effectively. Again, productivity is the key to bargaining. An employer faced with losing a productive employee will bargain effectively with the individual . . . The right to spend his income as he chooses—he should not be forced to spend his income for union dues and welfare funds.

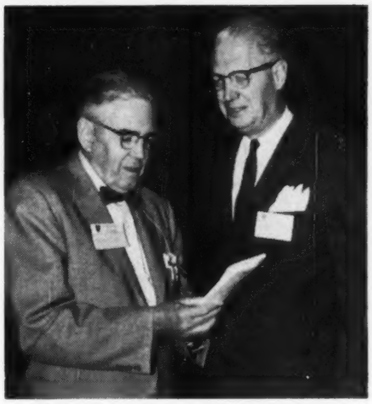
"Unions have reduced the individual to the level of the collective organization which was formed to perform the bargaining function. The effect of a collective organization is to average the individual characteristics of the engineer. Service to society is impaired when individualism is curtailed . . . The engineer's loyalty to his client, whether the client be employer or private individual, should be paramount. Loyalty to a union is impossible if the professional attitude is to prevail . . ."

W. J. Carroll, Jr., with a consulting firm in Pasadena, cited the fact that organized labor discourages professional individuality and professional unions as evidence of the incompatibility of unionism and professionalism. Unions state you will get more from society by demanding more. Engineers in a union would be restrained in technical advances that might reduce the number of members controlled by a leader.

Clair Hill, of Redding, Calif., speaking from the floor, brought out the hard fact that unions do exist and that some employers have to get along with their members. He suggested more thought and action along this line.

A Conditions of Practice session was devoted to discussion of the Model Law proposed by the National Council of State Boards of Engineering Examiners. ASCE committees have suggested changes—some have been made, but two important ones have not. ASCE favors limitation of corporate practice to organizations having a majority of ownership held by engineers and a majority of the directors registered engineers. (In approving the Conditions of Practice recommendation, the Board of Direction added the proviso that the president of the group should be a registered engineer.) This is more fully covered elsewhere in this issue. Greater recognition for surveying was asked with a simple change from "surveys" to "surveying" in the NCSBEE Definition of Engineering. Inclusion of the word "surveying" in the legal definition would give a state board of registration authority to recognize professional level surveying as qualifying experience toward engineering registration. The Committee on Registration suggests that state boards should immediately adopt for their own guidance the classification chart prepared by the Task Committee on Surveying and Mapping (CIVIL ENGINEERING, May 1959, vol. page 348).

Leading off in a session on Engineers in Public Practice, Randle B. Alexander, of the Texas Highway Department, pointed out that the great increase in projects financed with public money is causing an influx of engineers into public practice. The professional goals of engineers in public practice are important to the public and to the engineer himself. The engineer has for a client the public—made up of taxpayers, many of whom think superficially but feel deeply about the project under design or construction. In view of this the engineer must be able to explain and even defend his design in such a manner that the lay-



G. Brooks Earnest, right, Board of Direction nominee for next president of ASCE, chats with Harold W. Yost, of host Arizona Section, at the Phoenix Convention.

President Glenn Holcomb (left) is welcomed to Phoenix for the Convention by Governor Paul Fannin, of Arizona, and Elmer Maggi, general chairman of the ASCE Convention committee. Governor Fannin is shown signing a proclamation declaring Convention week, April 10-14, as "Civil Engineers Week" in Arizona.

A Construction Division session on planning for the Mammoth Pool Project in California brought together (in usual order), George W. Saul, of the Bechtel Corp.; Boyd Paulson, of the Utah Construction and Mining Co.; Neville S. Long, of the Southern Calif. Edison Co.; B. L. Perkins, of Morrison-Knudsen; and Lars Holmquist, of Consolidated Western Steel.

Distaff group at the Phoenix Convention includes (left to right), Mrs. Elmer Maggi, chairman of the Ladies Activities Committee; Mrs. M. J. Shelton, La Mesa, Calif.; Mrs. L. R. Howson, Chicago; Mrs. E. L. Chandler, New York; and Mrs. G. Brooks Earnest, Cleveland, wife of the official nominee for president.

The Committee on Registration of Engineers sponsored a session on its favorite subject, with Ellis Paul (center) in the chair. Speakers were William A. White (at left), James M. Congwer, and George W. Bradshaw. Don King, Assistant to the Secretary ASCE, is at the right.

The ladies set up their hospitality operation outdoors in the lovely patio of the Westward Ho Hotel. Pictured here, in usual order, are Mrs. Waldo Bowman, of New York; Mrs. Andrew Marum, of Tucson; Mrs. Edward Fraedrich, of Phoenix (Mr. Fraedrich is president of the Arizona Section); Mrs. Daniel Ventres, of Washington; and Mrs. Leigh Gardner, of Phoenix, hostess.

man taxpayer can at least understand what is being done. Where the engineer in private practice may be called upon to design a facility to fulfill a specific need for a limited time, the public engineer must design for the future—into which he may be able to see a bit further than the citizen taxpayer.

Every effort must be made to keep engineering out of politics. The engineer's decisions must not only be correct, they must appear reasonable to the layman. The engineer must be prepared to defend the decision not only to his manager but, perhaps, to another engineer called in by some opposing tax-paying body or entity. He must be able to say "No" gracefully but at the same time convincingly.

M. J. Shelton, now with a consulting firm but for many years with a public agency, sees little basic difference in engineers in either employ. "We are all in the profession of engineering and trained primarily to serve the public interest," he said. "My personal experience is that my performance and effectiveness have been much the same in either employment. Most of us are experienced in a specialized field of engineering. Selecting any particular field and given a problem, the solution then is one of judgment based upon experience and application of scientific theories . . . The fact is that a large majority of the engineers in private practice are actually working in the field of public practice since they are employed by a public agency to design a certain project. The big difference is that the next project may be designed under contract for another public agency."

At the same session Blucher A. Poole, of the Indiana State Board of Health, told of the problems of lower pay for public servants and continually changing political administrators. "Many of the problems of publicly employed engineers could be resolved simply by placing engineers in policy-making positions," he said.

Water featured in technical sessions

Water for the dry Southwest and the increasing need for water conservation and reuse throughout the country was the principal theme of the technical sessions at the Phoenix Convention. Many of the Technical Division programs hinged on water—desalting, conserving, using, reusing, piping—and construction for its transport and containment. There were five joint sessions on Water Resources in addition to water-oriented programs sponsored by each of eight Divisions.

Reuse of waste water, it seemed to be agreed, is the greatest single source

of additional water. Even in water-short Southern California only 6.3 percent of water is reused—only 1 percent from the City and County of Los Angeles. This latter figure is believed to be near the national average by Prof. Robert C. Mertz, of the University of Southern California, and Prof. Nelson L. Nemerow, of Syracuse University. Their paper quoted the U. S. Public Health Service, "that the pollution of our streams is occurring at a faster rate than treatment of waters for reuse; that the construction of 4,000 new sewage treatment plants and the modernization of 1,700 more is urgently needed to handle the present load of municipal sewage dumped into the nation's rivers and streams. The cost is estimated at $4.6 billion, only a little more that twice what California will spend over the next 20 years to bring Feather River water from the north and distribute it to the arid south, water which will also have to be subjected to adequate treatment after being used but once."

The Research Committee of the Sanitary Engineering Division is attempting to initiate studies leading to more reuse of waste waters. Funds are needed. The initial project will be carried out over a five-year period at four educational institutions—the University of Florida, Syracuse University, the University of Southern California, and the University of Washington—with technical assistance being sought from the Public Health Service, the National Association of Manufacturers, and the Department of Agriculture. The plan is to include seven phases of research study: Waste water analyses, industrial water requirements, removal of biological flora and fauna, removal of dissolved organic matter, removal of mineral matter, removal of suspended solids, and cost analyses.

John C. Merrell, Jr., of the District Public Works Office for the 11th Naval District, San Diego, told of the use of effluent on Navy installation golf courses, commenting that, "Reuse of a domestic effluent for irrigation purposes provides the optimum use since organic nutrients in the effluents are utilized and water quality is most compatible with the secondary use." He noted that recharge of effluent waters into ground-water basins has prevented salt water intrusion and increased the potential water supply, but is subject to limitation based on amounts and quality of diluting ground waters.

Usable water expensive

The Sanitary Engineering Division also featured water for the future in its papers. Their approach is through better management and reclamation with a warning that a lot of research first and then a lot of money will be needed to keep the United States properly supplied with water. Paul W. Eastman, Jr., of the U. S. Public Health Service, predicted that annual waste-collection and treatment costs will double by 1980 and almost quadruple by the year 2000, with the cost set at 3.6 billion dollars for that year. Major pollution sources are from households, and the manufacture of foods, paper, chemicals and petroleum products.

Information is not being divulged as to what is seen on the card being shown to President Holcomb, Vice President Molineaux, Executive Secretary Wisely, and Vice President Mattern (standing, left to right). Seated are Vice President Hedley and former Vice President Knapp.

Water from the sea

The Construction Division got into the water field in a big way with a session on salt-water conversion plants, one on planning for the Mammoth Pool Project, and one on Glen Canyon Dam. Under the office of Saline Water of the U. S. Department of the Interior four experimental plants are being constructed and a fifth is to follow. Basically there are two ways to convert saline water—that is, either to take the water out of the salt (distillation and freezing) or take the salt out of the water (membrane electrodialysis). A new plant at Freeport, Tex., will be a one-mgd long-tube vertical, falling-film-type, twelve-effect distillation unit, scheduled to go into operation this spring. Engineers A. N. Chirico and J. T. Dunn, of the Chicago Bridge and Iron Company, expect to produce usable water for about $1.00 per 1,000 gal. They predict that a similar-capacity plant might produce at 60 cents per 1,000 gal and a 20-mgd plant at 40 cents per 1,000 gal.

Another one-mgd plant at San Diego is expected to be in operation in November of this year and to produce water at about $1.00 per 1,000 gal. There are 36 stages of distillation in a multi-stage flash plant that utilizes heat from residual oil in a conventional packaged boiler. It is expected that the solid content of the water will be reduced to 50 ppm, far lower than San Diego's present supply.

A plant under construction at Webster, S.C., is to process 250,000 gpd by electrodialysis, which entails a stack of thin membranes and electric current to separate the dissolved salts. A plant of similar size being built at Roswell, N. Mex., will operate by forced circulation and vapor recompression. A plant utilizing freezing is to be constructed at Wrightsville Beach, N. C., but its size has not been announced.

The Southern California Edison Company is operating a sea-water conversion plant as an adjunct to the Mandalay steam power station. The plant is being operated primarily for research on a three-year test program, but it does produce for plant use about 100,000 gpd of water that is of much higher quality than that available locally. The operating cost is 80 cents per 1,000 gal, to which might be added $1.12 of fixed operating charges from the plant making a total of $1.92. Ralph W. Spencer, manager of engineering for the utility, estimates that a one-mgd plant would have an operating cost of 47 cents per thousand gallons, but a total cost

James D. King, hotel arrangements chairman for the Phoenix Convention, points out details of a "junior interchange" developed by Herman L. Danforth of Tucson as a means of taking through passenger traffic under cross streets at low cost while truck and turning traffic moves on surface.

for a tax-paying owner, including a return on investment, of $1.27 cents.

One of the papers brought out that fresh water from sea water can be produced by solar distillation. Despite the advantages of free power, so much capital equipment would be required that production costs are estimated at $2.00 per 1,000 gal.

The interior watersheds of Texas are being studied by a commission to coordinate the 18 federal, nine state, and more than 450 local water districts that have something to do with the interior watersheds of Texas.

Rolland F. Kaser, chief planning engineer of the U. S. Study Commission—Texas, said that by the year 2010 an area in Texas can achieve production goals representing a reasonable proportion of the food and fiber requirements of a nation with a population of 380 million without additional water resources development. He predicts that production per acre of many crops, such as citrus fruits, cotton, wheat, and the like, will at least double in the next fifty years.

Director Fred H. Rhodes Jr., (left) takes time out at the barbecue to talk engineering education with Gene Nordby and Al Golze.

Sediment continues to be a serious problem for the Colorado River and a continually changing problem as dams are added and diversions change. Paul A. Oliver, of the Bureau of Reclamation, said that developments are being watched to determine if rivers can be allowed to proceed in their normal course or if steps must be taken to assist the river in the management of its sediment load.

Seepage through canal linings of irrigation projects is a serious loss in our water resources. P. W. Terrell, of the Bureau of Reclamation, pointed out that 40,000,000 sq yd of lining have been placed by the Bureau in the past 15 years, but that further development through research is required. Linings and methods that will adequately control seepage and resist corrosion are now available at a cost that has been reduced during the past 15 years, despite generally rising prices, but the cost still is considerable and must be reduced further. Research will pay off as good linings, low enough in cost to be more widely used, will save valuable water.

Highways for today and tomorrow

Highway Division papers were geared to controlling the flood of traffic and planning for a much bigger highway future. William E. Willey, state highway engineer of Arizona, said, "We made forecasts of future traffic during the 1930's, and there was not one of us bold enough to estimate what has actually happened. Even today we hesitate to forecast traffic volumes based on past increases. There is a national tendency to think that there will be a leveling-off period. If the experience of the past ten years can be used as a guide, no leveling-off plateau is indicated for the next ten to twenty years."

Many people do not wish to meet the cost of needed roads and streets. Perhaps the least painful method of raising funds is a slight increase in the gasoline tax and a not so large bond issue. Mr. Willey is against concentrating great volumes of highway traffic in narrow channels and commented that there would probably never be another four-level structure built. The problem points up the need for more traffic engineers who are now in short supply and will occupy a major place in future highway and road planning.

City-county coordination in planning urban transportation systems is a solution being worked out by Los Angeles, City Engineer Lyall A. Pardee told a highway group. The Los Angeles metropolitan area has 71 cities, 6,000,000 people, and 325,000,000 vehicles. The several local groups expect to come up with a complete pattern of movement of people and goods for each five-year interval to 1980. This will give a complete analysis of transportation needs, daily traffic volume, probable land use and the like on computer cards for rapid determination of specific needs.

An interesting means of reducing the problem of intersections was advanced by Herman L. Danforth, of Tucson. He advocates "a sort of junior-grade diamond interchange, embodying an underpass that would provide 8 ft of clearance to accommodate automobile traffic. Trucks, buses and turning traffic would be accommodated at grade along with the cross traffic. The underpass would be oriented in the direction of major movement. Movements at grade would be controlled by signals in a conventional manner that would benefit through a substantial increase in the "green time" available. Cost would be substantially lower than for a conventional interchange.

Charles E. De Leuw, of the Chicago consulting firm of De Leuw, Cather & Co., pointed out that the Kennedy administration has a difficult decision to make regarding financing and completion time of the new federal highway system. Every organized group (Mr. De Leuw specifically pointed out the trucking industry) is vehemently against any increase in its share of the cost, but all are anxious to have the entire road system completed at once. New interest is thus being generated in the use of toll-financing techniques and a federal guarantee on the bonds for those which show definite promise of adequate earnings to amortize the investment. This would require minimum expenditure of federal funds. Toll roads ordinarily have been opened to traffic within three years of arrangements for financing, and people can decide for themselves whether or not they use the toll facilities as an adjunct to the free highway system.

Women shoppers prefer parking at an angle of less than 90 deg. Men prefer right-angle parking and backing into the space. All parkers will put up with inconveniences in favor of a location close to their destination. These are some observations presented by Merritt A. Neale, executive director of the Public Parking Authority of Pittsburgh. Public garages in that city are designed to accommodate the users, in so far as possible. A live load of 50 psf on all floors, 70 psf for the roof, has been found adequate. A steel-framed garage was built at a cost of $1,543 per car space or $4.79 per sq ft. One garage in an area of

rapid turnover has 60-deg parking, wide spaces, and other special conveniences for the driver. It cost $2,800 per car, but the factor of greater occupancy and turnover is rapidly paying the extra cost.

Much for civil engineers

William H. Claire, consulting engineer of Pasadena, Calif., in a paper on "The Civil Engineer's Contribution to City Planning," outlined some of the tasks confronting engineers in the next ten years. These include: Housing an increase of 40,000,000 people in 15,000,000 dwelling units, most of which will be in apartment units in urban areas; building thousands of miles of freeways with mass rapid public transportation in the median strip; creating parking spaces for an additional 12,000,000 cars; providing airport facilities for an additional 20 billion revenue passenger miles of airline traffic, for an average of 47 billion miles annually; and installing thousands of miles of moving sidewalks and conveyor belts for the convenience and efficient movement of people and goods in densely populated areas. The civil engineer with his ingenuity, creativity, intelligence, and foresight has as much or more to offer than any other professional in planning this work and a reputation and capacity beyond any profession for getting the work done, Mr. Claire concluded.

Many of the interesting papers on water from the Irrigation and Drainage, Hydraulics, Waterways and Harbors, and Pipeline Divisions will appear in ASCE publications. They cover almost every facet of water utilization.

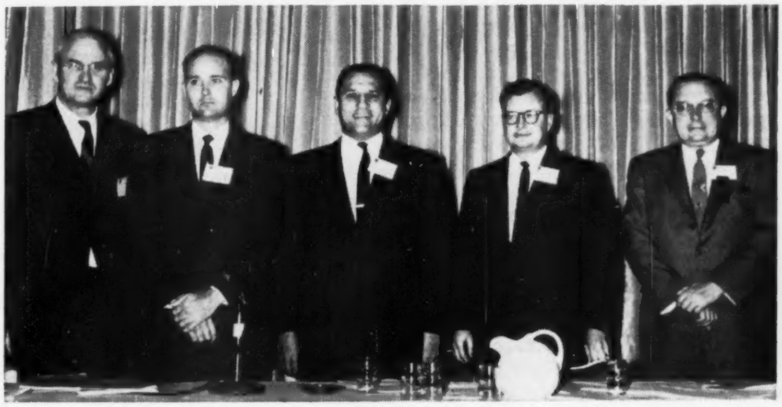
Soils Mechanics and Foundations Division papers featured seepage and drainage at dams and levees along with uplift and tunneling. The Power Division covered hydro and thermal plants, including nuclear reactors, with water conservation by cooling ponds and pumped storage, in interesting papers.

A well-attended Faculty Advisers Conference and a Pacific Southwest Conference Student Paper Contest filled the closing days of the Convention. Students in competition came from as far as Hawaii.

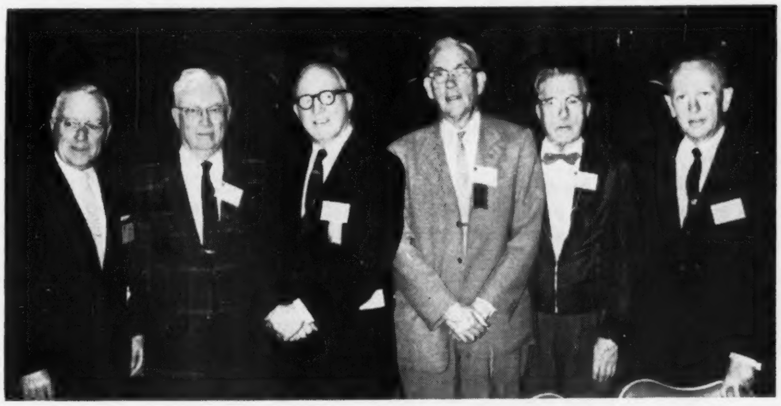
About 150 participated in the post-Convention tour to Glen Canyon Dam and the Grand Canyon of the Colorado. Weather was perfect as the engineers viewed concrete placing at a rate of 10,000 cu yd per day.

Several engineers took the planned tour to Hawaii where the Local Section was host for technical sessions and gala entertainment.

R. J. McMullin (left), general manager of the Salt River Project, was the Thursday luncheon speaker. He is shown here with Phoenix Convention committee members: Elmer J. Maggi, R. M. Cushing, W. I. Tizard, E. J. Waltenspiel, and J. H. Deatherage.



Unions and professionalism were discussed in Conditions of Practice session moderated by Glenn L. Enke, left. Others in the panel were T. C. Ewbank, Philip Abrams, and W. J. Carroll, Jr. At right is Trent Dames, Board of Direction contact member to the Committee on Younger Members.



Past Presidents of ASCE get together at the Phoenix Convention. Shown, in usual order, are Gail A. Hathaway (1951), Louis R. Howson (1958), Francis S. Friel (1959), Frank A. Marston (1960), John C. Stevens (1945), and Mason G. Lockwood (1957).

Board of Direction Meets in Phoenix

The Board of Direction of ASCE met at Phoenix coincident with the Convention. Official actions included the selection of G. Brooks Earnest, president of Fenn College, Cleveland, as the official nominee for President of ASCE for next year (see page 49), and nomination of four new Honorary Members: Samuel Morris, George Richardson, Thorndike Saville, and Abel Wolman (page 78). Other Board actions of special interest are briefed here:

Code of Ethics

The Board approved a revised **Code of Ethics** and supplementary Rules of Professional Conduct, which interpret the Code. The revised Code will appear in a later issue.

Some advertising by engineering-construction firms appears to be at variance with the intent of the ASCE Code of Ethics. An educational approach is to be tried with such firms, asking their cooperation in maintaining professional standards in this field.

Engineers doing work abroad are asked to conduct themselves in accord with the standards of the country in which they are working, adhering as closely as practical to the principles of the ASCE Code of Ethics.

Expulsions

Gerard J. Brinkman, who has been under suspension from the Society since 1956 **for violation of Articles 1 and 10** of the Code of Ethics, was expelled.

Thomas Worcester was expelled from membership in the Society **for violation of Article 10** of the Code of Ethics.

[It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers:

1. **To act for his clients or for his employers in professional matters otherwise than as a faithful agent or trustee, or to accept any remuneration other than his stated charges for services rendered his clients.**

10. **To act in any manner or engage in any practice which will tend to bring discredit on the honor or dignity of the engineering profession.** *ASCE Code of Ethics.*]

(Other cases of violation of the ASCE Code of Ethics are under investigation by the Committee on Professional Conduct. It is the policy of the Board of Direction to publicize only cases where disciplinary action is taken.)

Corporate Practice of Engineering

Acting on a proposed revision of the **"Model Law"** for registration of engineers (page 58), the Board of Direction is willing to permit corporate practice of engineering, provided a majority of the directors and officers of the corporation and the president are registered engineers and a majority of stock ownership is held by registered engineers. Included in the draft of the Model Law is a statement, found acceptable, that this provision shall not apply to engineering incidental to the manufacture of a corporation's own product.

Loan to UET

The Board ruled that ASCE will loan the United Engineering Trustees $60,000, interest free, until paid pledges of ASCE members for construction of the **United Engineering Center** reach the assigned $800,000 goal. (About $820,000 has been pledged by ASCE members, of which $740,000 has now been actually paid. More cash is needed as the building approaches completion.) The $60,000 loan will be repaid by UET as unpaid pledge payments are received.

Legislation

The Board of Direction endorsed **H.R. 5563,** proposing a separate professional personnel classification system in the Federal Government. It also endorsed **H.R. 924,** which would allow rapid amortization of private expenditures to ameliorate air and water pollution. The Board favors continuing research, but did not support a "crash" program for developing usable water through the U.S. Office of Saline Water. Consensus was that the realistic answer to the nation's water needs lies in proper use and development of all water resources.

National Highway Week

National Highway Week, May 21-27, as proclaimed by President Kennedy, was officially endorsed. ASCE Local Sections are urged to take appropriate action in their own areas.

Technical Divisions

The Board adopted as ASCE policy a statement, "Principles Governing the Professional Practice of Soil Mechanics and Foundation Engineering," prepared by the **Soil Mechanics and Foundations Division.** The statement will be widely distributed by ASCE.

The Surveying and Mapping Division was asked to prepare a policy statement on professional work in that field and to suggest a schedule of fees.

New Groups Authorized

Formation of a **Student Chapter** at Brigham Young University was authorized. Establishment of **student clubs** at the College of the Pacific, St. Louis University, Merrimack College, Bradley University, and Tennessee Polytechnic Institute was also authorized.

John A. Zecca Commended

The Board passed a resolution of appreciation, commending **John A. Zecca** for thirty years of service on the ASCE staff. Mr. Zecca resigned as comptroller last fall to enter a brokerage office.

New Branches Authorized

The Board authorized (1) formation of Branches in the Lansing-Jackson, the Southeast Area, and at Grand Rapids within the **Michigan Section;** (2) an Ashland-Mansfield Branch of the **Cleveland Section;** (3) a Southeastern Branch in **South Carolina** and (4) renaming **Montana's** Billings and Helena Branches the Eastern Branch and Western Branch.

Awards and Appointments

Finley Laverty, of Los Angeles, was named to receive the Professional Recognition Award.

Herschel H. Allen, of Baltimore, Md., was selected to receive the Ernest E. Howard Award.

Robert Brown Anderson, of Carnegie Institute, was named winner of the $5,000 ASCE Research Award. His study is in the field of brittle fractures.

Charles Merrill Barber, consulting engineer of Cleveland, Ohio, was se-

lected as ASCE Director for District 9 to replace John Scalzi who has moved out of the District and is no longer eligible to represent the area. (An outline of Mr. Barber's career will appear in a later issue.)

President Glenn W. Holcomb, with Clinton D. Hanover as alternate, will serve on the John Fritz Medal Board of Award after the expiration of Past President Howson's term on September 30.

By reason of the fact that the membership of ASCE exceeds 45,000 the Society is entitled to an additional director on the Engineers Joint Council Board of Direction. E. L. Chandler was appointed for a three-year term and Past President E. R. Needles as an alternate for two years.

Daniel B. Ventres was appointed to the Committee on George Washington Memorials.

John F. Seifried was appointed to a two-year term on the Washington Award Commission.

Hal W. Hunt was appointed to the Control Committee of the Engineering Societies Personnel Service.

The Board voted to support Dr. Edward Teller for the Neils Bohr International Gold Medal.

Policy Changes

Details of Board action on changes in administration of Society prizes and policies, with regard to provision for instruction in surveying will appear in the June issue.

New Optional Insurance Benefits For Members

The Board of Direction, at its April meeting in Phoenix, approved optional High-Limit Accidental Death and Dismemberment coverage to supplement the $7,500 Accidental Death and Dismemberment coverage, which is now part of the Society's Disability Income Protection Plan. The new supplemental optional coverage will be made available in accordance with the following schedule:

- Under age 70, available up to a maximum of $200,000, in units of $25,000, at the low cost of 90 cents per $1,000.
- Over age 70, the maximum will be $100,000 at $1.35 per $1,000.
- $25,000 protection will also be available to spouses of members.
- There will be no health requirements for coverage of $100,000 or less.

A brochure containing full details of this new coverage will be mailed to all members during May.

G. Brooks Earnest Nominated for President of ASCE

G. Brooks Earnest, widely known in the field of engineering education and president of Fenn College, Cleveland, has been selected by the Board of Direction as the official nominee for 1962 President of the Society. Election will be by letter ballot during the summer, with installation during the

Society's Annual Convention, to be held in New York, October 16-20. Professor Earnest has represented Zone III on the ASCE Board of Direction—as Director from 1950 to 1952, and as Vice President in 1953 and 1954.

A graduate of the Case School of Applied Science (now Case Institute of Technology), he returned to his alma mater in 1930 as an instructor in civil engineering. He obtained his M.S. degree in civil engineering in 1933, became assistant professor in 1935, associate professor in 1942, and professor of engineering surveying in 1948. In 1951 he went to Fenn College as dean of engineering, and in the spring of 1953 was inducted into the presidency after several months as acting president.

Professor Earnest has given generously of his time and talents to civic and allied activities as well as to service to the profession. For many years associate director and, later, consulting director of the Cleveland Regional Geodetic Survey, he organized the first large-scale city mapping program using photogrammetric procedures. He was on the Mayor's Committee on City Planning, which recommended the existing City Planning Department setup for Cleveland, and on the Advisory Committee to the Cleveland Transit Board, which recommended the present rapid-transit program.

Long active in the ASCE Cleveland Section, Professor Earnest served as secretary-treasurer from 1938 to 1941, vice president in 1942, president in 1943, and on its board of direction from 1944 to 1949. At national level, his services to the Society include membership on the Executive Committee; the Division of Surveying and Mapping, of which he was chairman in 1947; and the Committee on Student Chapters, of which he was chairman in 1947.

Professor Earnest is the author of a number of articles, largely on the Cleveland Regional Geodetic Survey control and aerial mapping project, which have appeared in CIVIL ENGINEERING, *Photogrammetric Engineering, Engineering News-Record* and *The American City*. He is co-author of "Specifications for Topographic Surveys," which appeared in *Proceedings* for March 1946.

SOCIETY AWARDS AND FELLOWSHIPS AVAILABLE

DANIEL W. MEAD PRIZES:	*1961 contest closes June 1, 1961. See 1961 Official Register, page 152, and January 1961 CIVIL ENGINEERING, page 72.*
FREEMAN FELLOWSHIP:	*1961 contest closed. New contest opens. See Official Register, page 158.*
J. WALDO SMITH HYDRAULIC FELLOWSHIP:	*1961-62 contest closed. No 1962-63 contest offered.*
RESEARCH FELLOWSHIP:	*New contest closes Jan. 1, 1962.*
ERNEST E. HOWARD:	*New contest closes Feb. 1, 1962. See Official Register, page 151.*

(More ASCE News on Page 77)

Exploratory tests on a steel delta girder

HOMER M. HADLEY, F. ASCE, Consulting Engineer, Seattle, Wash.

Recent tests indicate that something can be done about the lack of lateral stiffness in long steel beams and girders. As spans lengthen, the width of flanges becomes increasingly unsatisfactory. With increased length the girders become springy, flexible and threaten to buckle or overturn. To this lack of lateral rigidity in steel members men intimately associated with steel erection give very convincing testimony. (See "Problems in Bridge Erection as Affected by Design Requirements," by E. L. Durkee, F. ASCE, Engineer of Erection, Bethlehem Steel Company. American Institute of Steel Construction, National Engineering Conference, 1959 Proceedings.)

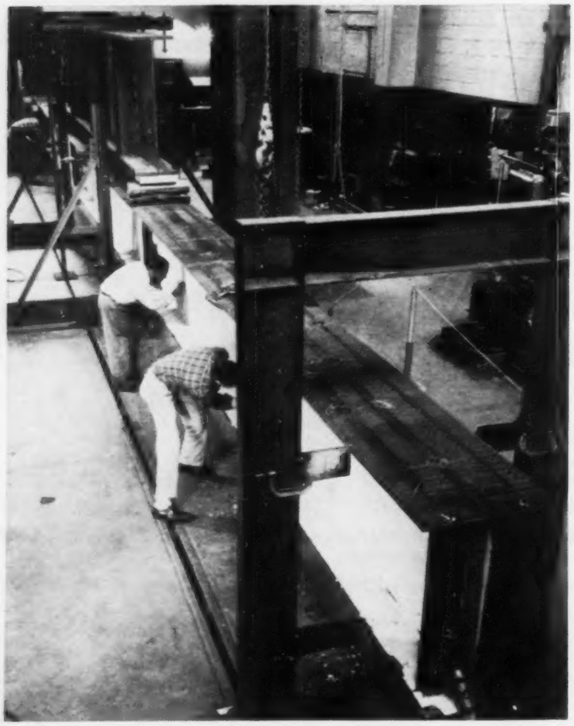
It was dissatisfaction with the width of some 120-ft girders, based on the 12 *t* (flange thickness) projection limitation, that led the writer to again consider this problem. Standard specifications do sanction a compressive plate thickness 1/40th of the distance between the nearest lines of support when there are two or more supports. Evidently then, a delta section not only would comply with standard specifications but likewise would provide a flange width proportionate to span needs while permitting a reduction in flange plate thickness.

The delta section comprises the basic web and flanges but, in addition, provides a pair of continuous diagonal plates that span and close off the reentrant corners between web and compression flange. In the girder tested these corner plates were welded to the web at its quarter-depth point, and welded to the top flange at a distance outward from the web plate about three-quarters of that at which they are connected to the web. These corner plates create a two-celled triangular box or shaft that is delta shaped in overall cross section and continuous from one end of the girder to the other. This section, to an extent unknown in conventional plate girders of comparable size, introduces torsional strength and stiffness in what heretofore has been the girder's most vulnerable part, the compressive zone.

Because of their position in the compressive zone, these corner plates not only stiffen against transverse rotation but by their own area add materially to the girder's longitudinal compressive section and strength. They make possible girder flanges of generous width, at least somewhat commensurate with the span length, since with the two additional flange supports they make available up to 80 *t* of additional flange width. The corner plates decidedly shorten the unsupported height of the web and reduce that exterior unbraced part of it which is still subject to compressive stress. The high shearing stresses in combination with the high compressive stresses of the single-web girder are radically reduced because above the junction point the shearing forces are divided about equally among the three plates—the two corner plates and the central web.

The corner plates eliminate the need for all stiffeners except bearing stiffeners and those required for cross-frame connections. In so doing they eliminate much welding transverse to stress on the tension side of the web. Being longitudinal members, the corner plates are adapted to machine welding and its economies as the conventional vertical stiffeners are not. The smooth unbroken surfaces of the resulting girder simplify sand-blasting and initial painting as well as any subsequent painting. With adequate lateral stiffness assured, transportation and erection of the delta girder is simplified. For composite construction, the contact area between concrete and steel is greatly increased. It may be added that the elimination of vertical stiffeners decidedly alters, and improves, the appearance of the girder.

Such broad claims obviously call



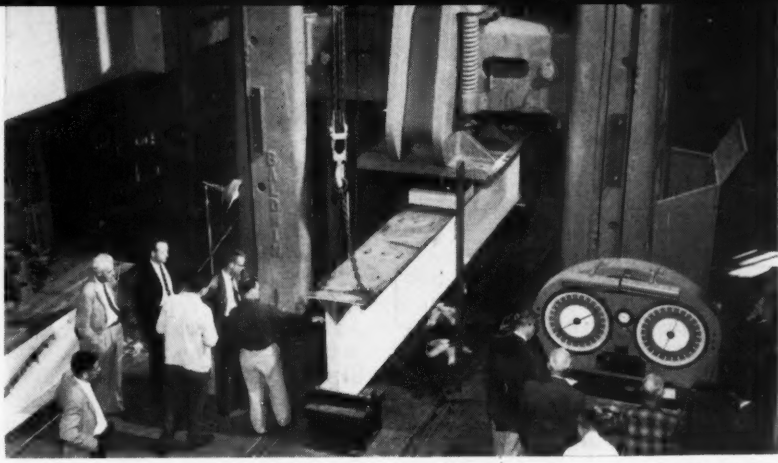
1. Test of 61-ft girder on a 60-ft span (Girder 1) continued until tension failure occurred—indicated by a marked increase in the deflection at midspan between applied loads of 140,000 and 162,600 lb. Web offset measurements showed no movement.

for substantiation. Tests were accordingly carried out as will be described. They were preliminary in nature yet in view of the large loads involved and the size of the sections it is evident that the physical properties of the test girder are not imaginary. The main purpose of the tests was to determine whether the corner plates would sufficiently stiffen the web to permit the omission of vertical stiffeners. It is believed that the tests showed they would do so.

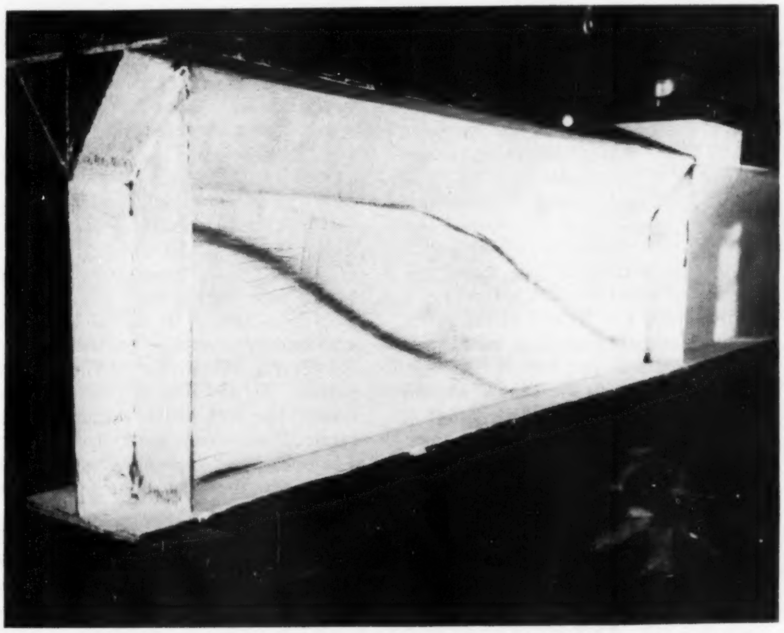
A test girder 61 ft in overall length, for testing on a 60-ft span, was commercially fabricated of A7 steel and was tested at the University of Washington. This girder, called Girder 1, is shown in section and elevation in Fig. 1. After it was tested on the 60-ft span, 21-ft lengths were cut off both ends of it, pairs of stiffeners were added to these ends at the mid point, and the end lengths (called Girders 2 and 3) were tested on 20-ft spans with a central load. Lastly the remaining central 19-ft section of the original girder (Girder 4) was provided with pairs of bearing stiffeners at both ends. It was tested, without central stiffeners, on an 18-ft span with the midspan load in two positions—centered directly over the web, and centered directly over a corner plate and therefore with a 7-in. eccentricity with respect to the girder's longitudinal axis.

Thus five separate tests were made, one on each of three girders and two on Girder 4. In all except the first test, pads of reinforced concrete, 2 ft square and 6 in. thick, made with high-early-strength cement, were formed and placed at midspan to simulate the concrete slab of a bridge deck and to effect, in a measure, corresponding distribution of load.

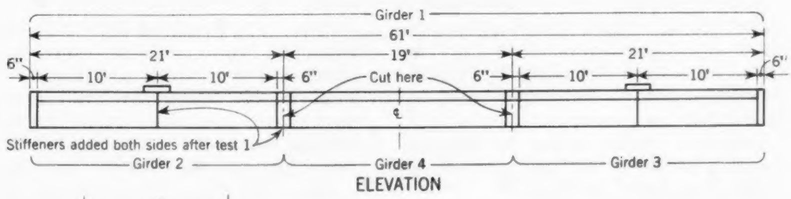
The test of Girder 1 (that of the 60-ft span, with third-point loading), went quietly and well. Loads were increased by 20,000-lb increments until a tension failure, indicated by a marked increase in the deflection at midspan, occurred between total applied loads of 140,000 and 162,600 lb. Practically vertical Luders lines, either individual or in fairly close groups, appeared on the corner plates adjacent to the loads and across the middle third of the beam. They appeared to be of no structural significance. No deformation of the corner plates or of the top flange was noted. Beneath the corner-plate junction point offset measurements were taken to the web from piano wires stretched the full length of the girder. These wires were located 9 in. and 18 in.

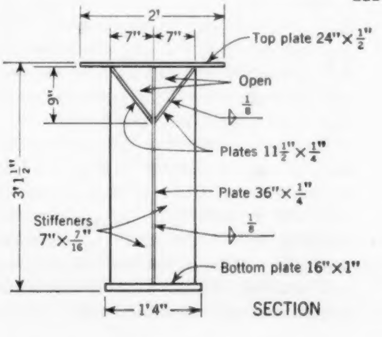


2. Section from other end of 61-ft girder, called Girder 3, was tested with the load centered on a 20-ft span and carried 335,000 lb. ultimate. Deformations, not so severe as in Girder 2, were about equal in the two web panels.



3. An interesting pattern of web deformations developed in Girder 3 during the test. Note that the triangular box portion of the girder remained unaffected.





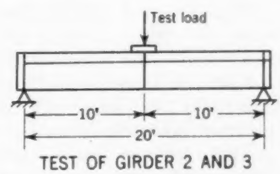


FIG. 1. Girder 61 ft long was first tested, then 21-ft sections were cut from each end and the end pieces as well as the center section were tested individually.

respectively above the bottom flange. No movement of the web was found. The maximum shear was 9410 psi. See Photo 1.

Tests on Girders 2 and 3 were made desirable by the lack of a conclusive shear determination in Test 1. That girder had behaved properly enough but how would it behave at high shears? In the test on Girder 2, with its midspan stiffener load on a 20-ft span, this girder carried 320,000 lb ultimate. During the application of the final 10 percent of this load, the girder deformed heavily, almost entirely in one of the two web panels created by the midspan stiffeners. The bottom-flange section to which this web panel was attached was correspondingly distorted. The triangular box portion of the section appeared to be unaffected. The unit shear was 17,950 psi.

The test on Girder 3, the opposite end of the original 61-ft girder, is seen in Photo 2. The ultimate load was 335,000 lb, and quite equal deformations appeared in the two web panels and with much less distortion. See Photo 3 for the interesting pattern of web deformations that resulted. Here again the triangular box portion of the girder remained unaffected. The unit shear was 18,870 psi.

The two tests on the central section of the original girder, called Girder 4, were made to answer the question: How will this girder behave when a heavy load is applied, not at the stiffeners but midway between them?

Test 4, with its load centered on an 18-ft span, was made to answer that question directly. The unsupported height of the web, from the corner-plate junction to the bottom flange, is 27 in. The distance between stiffeners is 18 ft. The aspect ratio of this girder is therefore (18.0) / (2.25) or 8, in interesting contrast to the conventional plate girder whose aspect ratio customarily ranges from 0.5 to 1.0. The load in this test was raised by 20,000-lb increments to 200,000 lb; then by 10,000-lb increments to 250,000 lb. This was by no means an ultimate load and the girder deformations at this stage were not great.

The principal deformation, and the most interesting, was in the web directly below the concrete loading pad. Patches of Luders lines, about 45 in. apart and 5 in. below the corner-plate junction point, developed rather early in the loading test. Between these there gradually appeared a connecting loop or festoon of Luders lines. These at final load were distinct and well defined and marked the ⅝-in. bowing outward of the web to the opposite side of the girder which had developed when loading was terminated at a unit shear of 14,030 psi and an f_s of 21,900 psi. Again, the delta portion of the girder appeared unaffected.

The final test on Girder 4, in which the load was applied eccentrically and over the outermost edge of a corner plate, was strictly exploratory, since, in an actual bridge, it is the roadway slab and not the girder that provides the necessary resistance to eccentric girder loads. Therefore this test was undertaken in a purely investigative spirit to find out just how the girder would behave under an eccentric load. The girder with the top plates was shifted laterally 7 in. on its bearings, leaving the hemispherical head centered under the testing machine head.

Up to a load of 175,000 to 180,000 lb the girder behaved no differently than under a centered load. At about this load, however, the entire triangular box in the vicinity of the load began to deflect and yield and twist, and the bearing plates on top of the concrete pad began to open and come apart on the side opposite to the load, while the hemispherical bearing plate gradually turned in its socket. The load had been applied on that side of the central web which previously had bulged. At 194,000 lb, with a loud boom, the web plate suddenly "oil-canned," reversing the bulge of Test 4 to one in the opposite direction with identically the same but a reversed offset of ⅝ in.

The load was discontinued at 200,000 lb, where a general spilling of hemispherical head and bearing plates was feared imminent. With the load removed the girder appeared remarkably unaffected by the test. The "oil-canning" had created the counterpart of the previous crescent pattern of Luders lines on the unmarked side of the web at midspan but the web, when measured with a straight-edge, was found to be vertical! On the other hand it was found that the corner plate on the load side, which had developed numerous perpendicular Luders lines along its length, now had various minor deviations, in and out, from its original plane surface. The greatest of these, ¼ in., came outside the bearing stiffeners at the extreme end of the girder. The opposite girder end was straight and unaffected.

The one difficulty concerning the second test of Girder 4 is to find an explanation of the fact that it carried 200,000 lb with 7 in. of eccentricity, creating 1,400,000 in.-lb of eccentric moment. If the resistance of the web and bearing stiffeners could somehow simultaneously develop with 33,000 psi of flexure—as it cannot—the applied moment would still be about 20 percent in excess of the resisting capacity of the girder section. Therefore it must be concluded that lateral restraint provided by the hemispherical head, plus transverse load distribution by bearing plates and reinforced concrete pad, account for a considerable portion of this total load and moment.

A few closing comments

In closing a few comments should be made.

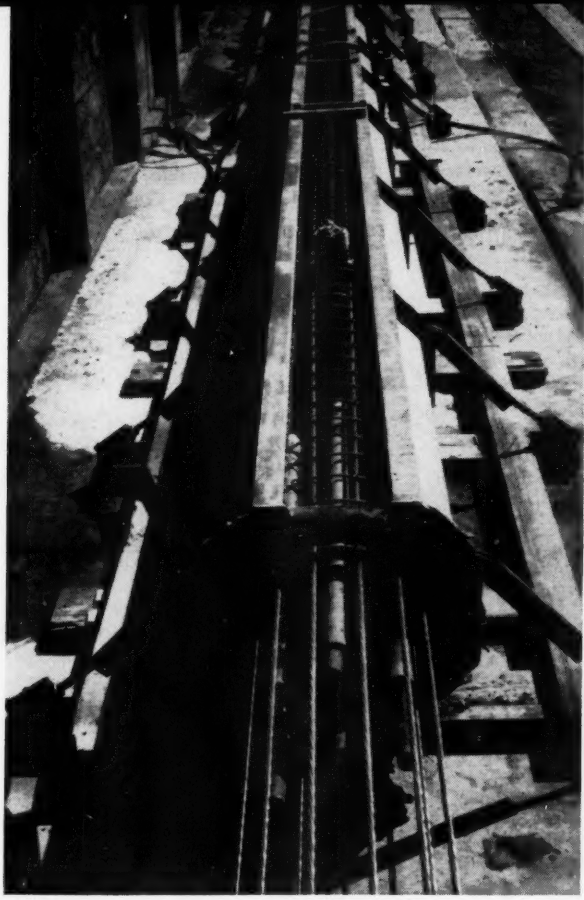
All tests were made on unbraced, free-standing sections which lacked the lateral support that roadway slab and cross-frames normally provide for the prototype bridge girder.

The general toughness and tenacity of steel was well illustrated in these tests. Except for the single case of "oil-canning," all deformations developed gradually. Even the extreme deformations in the test on Girder 2 came about slowly, and at maximum load the badly distorted girder was still intact and not in pieces.

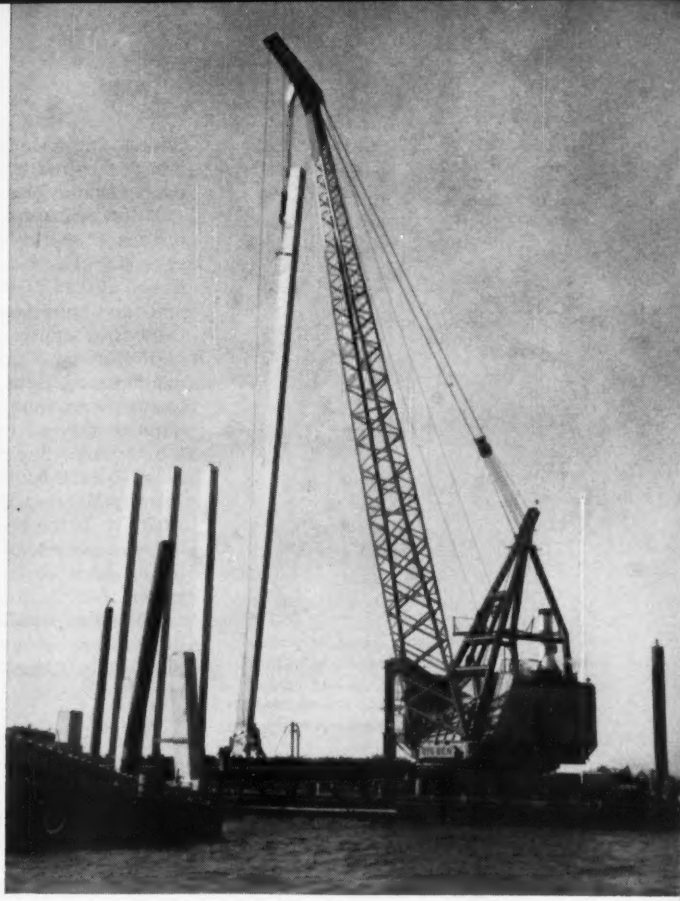
The position given to the corner plates in these girders is not necessarily the optimum one. It may well be that with deeper girders a $d/3$ position for the junction point would be better. The angular position of the corner plates appears to be good; it results in an approximately equilateral delta triangle.

The applied loads have been stated in pounds. Sometimes loads so stated seem meaningless as regards any practical application. In bridge design the H20-ton truck—40,000 lb—with 0.8 of that load on the rear axle, 14 ft behind the lead axle, is the maximum single truck unit employed. Converting the test loads into that unit, Girder 1 individually and without a deck slab carried 4 trucks. Girder 2 carried 8 trucks, concentrated on one spot. Girder 3 carried 8⅜ trucks, concentrated on one spot, and Girder 4 in its first test carried 6¼ trucks, concentrated on one spot. Finally, this girder carried 5 trucks, concentrated on one spot in an eccentrically applied load. It is submitted that for any and all of these girders, that is a lot of trucks.

These tests were made possible by the friendly interest and support of the Pacific Northwest Steel Fabricators Association and the American Institute of Steel Construction. To Prof. F. B. Farquharson, F. ASCE, and Assoc. Prof. Desi Vasarhelyi, M. ASCE, of the Department of Civil Engineering, University of Washington, thanks are due for their help, interest and advice. The design was by the writer.



Manufacture of pretensioned piles. A rubber tube was used in precasting the center void. Prestressing strands may be tensioned at one time on a bed that includes several pile lengths.



Pretensioned piles ready for driving in Tampa Bay Bridge, Fla. Pile is 24 in. square, with a 12-in-dia. void, and is stressed with twenty-four 7/16-in. strands. Photo courtesy of Wm. E. Dean.

Pretensioned concrete piles —present knowledge summarized

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Prestressed concrete has a unique application in the field of precast piles. The purpose of prestressing is to reduce or eliminate tensile stresses in the concrete. Since piles are subjected to tensile stresses during transportation, driving, and under certain service conditions, and since concrete is weak in tension, the desirability of prestressing is evident.

Post-tensioned concrete piles, essentially of the Raymond cylinder type, have been produced since 1949. About 1953, pretensioned concrete piles were developed; they are now readily available because of the establishment of hundreds of pretensioning plants throughout the country, and indeed all over the world.

In common with many construction materials and techniques, pretensioned concrete piles were developed by the industry rather than by the profession. A process of trial and error, rather than a rational approach, was employed during their development. At present, enough experience has been accumulated to permit safe and economical utilization of these piles.

The aim of this article is to summa-

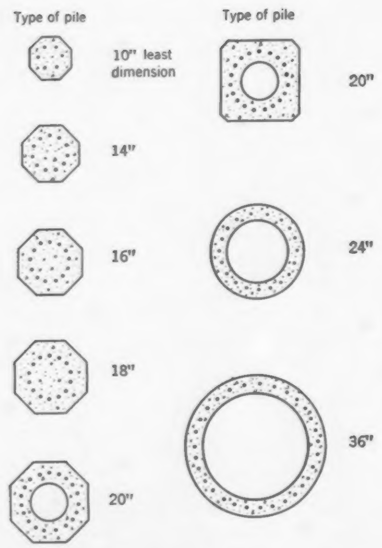


FIG. 1. Some typical sections of pretensioned piles. Large piles frequently are post-tensioned.

rize the current status of knowledge concerning these piles and to point out areas that deserve further study. Discussion follows under five headings: design, detailing, manufacture, driving, and applications.

Design

Experience seems to indicate that a prestress of about 700 psi in the piles will insure safety during handling and driving under normal conditions. While the amount of prestress required will vary with the size and shape of the pile, the hammer blow, and the cushioning effects, as well as the soil conditions, it is obviously impractical to vary the prestress in each pile. Of course higher or lower values than 700 psi may be desirable for special cases.

The bearing capacity of concrete piles is seldom if ever controlled by their strength under direct compression but it is convenient to express the bearing capacity in terms of the compressive strength or stresses. Strictly speaking, if the bearing capacity were limited by the compressive stress, there would be no need for prestressing. Therefore, current formulas are empirical in nature. For reference, they are outlined as follows.

Piles not subject to buckling. The design load on such piles is often based on the ultimate strength, using an arbitrary factor of safety of about 4. Such a high factor of safety is hardly necessary so far as the service load is concerned, but it is believed that, for piles so designed, the compressive stresses during driving will seldom be critical, and it should be possible to attain the desired bearing value without damaging the pile.

If the cylinder strength of the concrete is f_c', the ultimate strength of the concrete in a pile can be safely assumed as $0.85\ f_c'$. At ultimate load, the amount of prestress remaining in the tendons is approximately 60 percent of the effective prestress. Thus, if a 6,000-psi concrete pile is prestressed to an effective prestress of 700 psi, the ultimate strength can be computed by the formula,

$$N' = (0.85 \times 6{,}000 - 0.60 \times 700)\ A_c = 4{,}680\ A_c$$

where A_c is the cross-sectional area of the concrete pile in sq in. Using a factor of safety of 4, the design load, N, is one fourth of this, or $1{,}170\ A_c$.

Long, free-standing piles. The buckling load of a pretensioned concrete pile can be computed by Euler's formula,

$$N_{cr} = \frac{\pi^2 EI}{L^2}$$

where

N_{cr} = critical buckling load, in lb
E = modulus of elasticity for concrete, in psi
I = moment of inertia of concrete pile section, in in.^{4}
L = length of pile, in in.

The above formula assumes hinged supports for both ends and can be modified for other end conditions. The value of E should be chosen to fit the duration of loading—that is, a higher value should be used for dynamic load and a reduced value for sustained load. Since the possibility of an increase in actual load is remote, a factor of safety of 2 is considered sufficient. Thus the allowable load is often set at

$$N = \frac{N_{cr}}{2} = \frac{\pi^2 EI}{2\,L^2}$$

Moment-resisting piles. If no tensile stress is allowed, a high factor of safety is obtained for concentrically prestressed members subjected to bending. It is therefore often permissible to allow tensile stresses in the concrete under design moments. The amount of permissible tensile stress, f_t, will depend on the nature of the loads and the service conditions, values up to 600 psi having been permitted for earthquake or other infrequent loads. Thus, if f_c is the effective prestress in the pile concrete, the allowable moment under earthquake loading, in inch-pounds, will be,

$$M = (f_c + f_t)\ (I/c)$$

where

I = moment of inertia of concrete section, in in.^{4}
c = distance from neutral axis to extreme fiber, in in.

The ultimate moment, in inch-pounds, for a pretensioned pile can be approximated by,

$$M_{ult} = CA_s f_s' d$$

where

C = a coefficient depending on shape of pile section, etc., varying usually from 0.32 to 0.38
A_s = total area of prestressing steel, in sq in.
f_s' = ultimate strength of steel, in psi
d = diameter or size of pile, in in.

The design moment, based on the ultimate, should have a factor of safety of 2, while a factor of 1.5 to 1.7 will be sufficient for earthquake and wind loads.

Combined moment and direct loads. According to the elastic theory, the existence of direct external loads delays the cracking of the concrete pile and thereby increases the moment-carrying capacity. On the other hand, the ultimate moment capacity is reduced by the presence of direct external loads. Hence, when the design is for combined moment and direct loads, the moment capacity of the pile should be checked by both the elastic and the ultimate-load theories to insure safety.

Details and connections

Spiral steel. Some typical pretensioned pile sections are given in Fig. 1. These piles are usually pretensioned with 7-wire strands, from 3/8 to 1/2 in. in diameter. The spacing of spiral steel also was established by experience. Its design has not been rationalized, but it is generally agreed that steel of No. 5 gage about 0.2 in. in diameter, at a 6 to 9-in. pitch, will suffice for the middle part of the pile, while a 3-in. pitch is used for the end portions. Four or five tight turns at about a 1-in. pitch are usually extended to within around 1 in. of the end. For piles larger than 20 in. in cross section, spirals of 1/4-in. diameter are often used.

Pile connections. Where the pile tops are encased in a heavy footing, very often no connection other than sufficient embedment is required. In this case, the pile can be either driven to grade or cut off to the desired level with ordinary concrete chipping hammers.

If additional anchorage is required, one or more of the following types of connections can be used.

The prestressing strand can be extended from the pile head and used as reinforcement. Actual tests have shown that an embedment of 18 in. is adequate to develop the full strength of a strand of 3/8-in. diameter. The

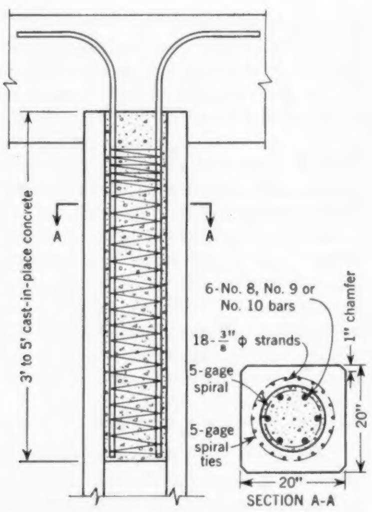


FIG. 2. Holes drilled or formed 3/4 in. or 1 in. larger than dowels, by light-weight tubing (without bond breaker or lubricant), provide adequate bond for reinforcing when carefully grouted. Section A-A shows method of ensuring load transfer for piles with 3/8-in. strand.

strands may be exposed by stripping off the concrete after driving. If the piles are to be driven to grade, the strand extension must be allowed for at the time of casting.

If the pile reinforcement consists of more than 12 or 14 strands, threading the projecting steel through the driving head becomes costly and time consuming. Since most precast piles are ordered slightly on the long side, it may be simpler to cut off the pile after driving and expose the reinforcing for anchorage. It should be noted that the full working strength of the strands cannot be developed as unprestressed reinforcement, owing to the excessive elongation that could be produced.

To post-tension a dozen or more small strands through the cap or footing is difficult and costly so that this method has not been used to any extent for pretensioned piles. In the post-tensioned pile, particularly where alloy bars of large diameter are used for reinforcement, a tensioned connection is easier to make and has been used in Europe, where fixity or full anchorage is required at the pile head.

Probably the most versatile and widely used connection of pile to cap is the simple reinforcing-bar anchorage similar to that used for many years in conventionally reinforced piles (Fig. 2). The reinforcing can be cast in the head of the prestressed pile where the piles can be driven reasonably close to final elevation, but a special driving head or follower must be used. Bars can be grouted into either precast holes or holes drilled after driving. If precast holes are to be used, the pile must be driven within 1 or 2 ft of final grade. With greater variations, the field-drilled holes may prove to be cheaper.

Pull-out tests have indicated that special grouting mixtures are not required to develop the full bond strength. A good plastic sand-and-cement grout with an ultimate strength equal to that of the pile, properly worked into place and cured, will be satisfactory. A water-reducing plasticizing admixture is desirable to reduce shrinkage.

For a pile with a hollow core, the connection can be made by using a poured-in-place concrete plug with an embedded reinforcing-steel cage placed inside the core and extended into the cap or footing (Fig. 3). Where welded connections are desired, they are provided by grouting a plate or other steel section into the pile with extended steel reinforcing bars attached. The connection is completed by welding to the superstructure.

Pile splicing. Splicing of precast piles can be rather difficult. The splice or extension should be at least as durable as the prestressed concrete section; it should have equivalent load-carrying capacity, bending and shear strength. The splice must be economical and must allow driving to be resumed within a reasonable time. Several methods have been developed and successfully used for splicing prestressed concrete piles.

A splice recently developed in Connecticut consists of two pretensioned sections joined by means of reinforcing steel dowels and a plasticized cement. The lower section is first driven and the head drilled to receive reinforcing bars cast in the upper section. The jointing compound is placed in a molten state and fills the dowel holes and the space between the pile sections. Because of the high strength and fast set of the cementing compound, the spliced section can be driven after a very short curing time. On the Pacific Coast, similar experimental splices have been made using a slower setting epoxy compound (Fig. 4).

A splice can be made by welding the two sections in the field using steel pipe sleeves or anchored plates embedded in the prestressed sections at the time of casting. An epoxy compound can be used between the concrete sections for load transfer.

Where full moment-carrying splices are not necessary, simpler connections can be used. In Honolulu, long piles composed of three prestressed sections were spliced by driving the upper section into a snugly fitting steel sleeve that had previously been driven over the lower section. A center dowel was used to align the two sections.

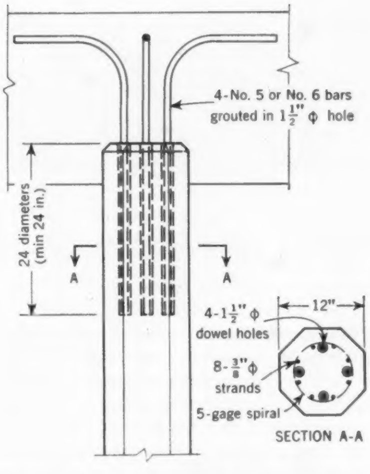


FIG. 3. Connection of a hollow pile to footing or bent, using steel dowels. The poured-in-place plug can be put at any depth by suspending an expendable form at the proper depth.

Manufacture

Pretensioned piles are usually manufactured by the long-line method; multiple sections are cast in a single stressing line up to perhaps 600 ft in length. Pretensioning is used for piles up to about 30 in. in cross-section, although it is possible to pretension larger sections if it is economical to set up the heavier tensioning bed and auxiliary equipment.

The pretensioning bed should be

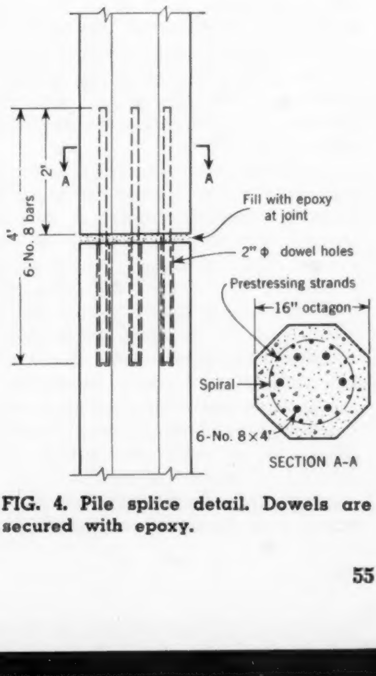


FIG. 4. Pile splice detail. Dowels are secured with epoxy.

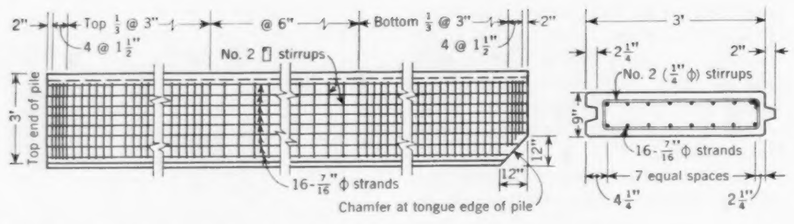


FIG. 5. A typical prestressed concrete sheetpile.

strong enough to resist the maximum stressing force to be applied, rigid enough to prevent excessive deflections, and accurately level so that the strands and the final product will be in true alignment. The strands can be stressed as a group by large-capacity jacks, or individually by single-strand jacks.

Forms for the piles should be preferably of steel, sufficiently rigid to eliminate distortion. Joints between sections, or at end forms, should be accurately fitted so that offsets or openings are eliminated. Thermal movements, particularly with high-temperature curing, can produce cracking at points where large offsets or fins restrict movement. Forms should be so constructed as to permit movement of the pile without damage during release of the prestressing force. The form at the pile ends should be perfectly square with the pile axis and reasonably plane. To form the core for hollow piles, either paraffin treated cardboard tubes or inflatable rubber mandrels are used.

Most pretensioned piles made in the United States have a square or octagonal cross section. The square section is perhaps somewhat easier to form and pour; the octagonal section is often preferred because of its smaller area and weight for a given least dimension. The octagonal pile requires a slightly more complicated form process, but generally requires less complicated spiral ties. Both fixed and collapsible-type steel forms are used for either type of pile.

Low-slump concrete with a cement content of 6½ to 8 sacks per cu yd is generally used to provide a 28-day strength of 4,500 to 7,000 psi. At the present time, the majority of the manufacturers use a water-reducing admixture of some kind. Calcium chloride should not be used. Most piling specifications require Type II low-alkali cement, particularly where piles are used in sea water, although cements of Types I and III are occasionally permitted. Aggregates usually are ¾ to 1 in. in maximum size.

When the concrete is placed, particular care should be taken to insure that the head and tip are well vibrated as these areas usually have close spiral or tie spacing and may have dowels or tubes for preformed holes at the head. In the case of piles with a hollow core formed with paper tubes or inflated rubber tubes, it is necessary to provide external hold-downs at intervals close enough to prevent flotation or deflection of the tube. Attempts to secure the tube by means of the encircling strands usually result in excessive flotation or deflection on all but very short piles.

Since economy in manufacture requires a rapid turnover of piles on the casting bed, most producers of pretensioned piles employ accelerated curing. Low-pressure steam, radiant heat, and hot air are all used for curing. Curing is usually done at temperatures ranging from 130 to 165 deg F for 10 to 18 hours. In hot, arid areas, additional water or membrane curing may be required for an additional 7 to 10 days. In most cases air curing will develop the required ultimate strengths before 28 days.

Since pretensioned piles employ concentric prestressing seldom exceeding 1,000 psi, the primary consideration is bond rather than compression or tension in the concrete at stress transfer. Concrete strengths for stress release are generally set at 3,500 psi as a minimum for 7/16 and 3/8-in. strands. Minimum transfer strengths are usually adequate for handling of the section so that piles can be removed from beds immediately after stress transfer.

Driving

Prestressed concrete piles have proven their ability to take an unbelievable amount of punishment without structural damage. They are very strong in bending but are not indestructible. Experience has shown that if the criteria of no tension in the concrete is used for handling and transporting, a sufficient factor of safety against cracking is available to take care of impact and shock loads for all but extreme cases. When no extra loads are expected, tensile stresses may be permitted during handling.

As mentioned under "manufacture," the pile head must be truly perpendicular to the pile axis and reasonably plane. Irregular or inclined heads tend to concentrate the driving blow and may cause spalling or cracking at the head. The wire strands should be burned flush with the pile head. Projecting wire stubs, even when covered by a cushion block, have been known to cause spalling at the head. A chamfered edge at the head also helps to prevent spalling. If jetting is required, the internal-type jet has proved superior to the external type in preventing wandering of the pile tip and consequent eccentricity during driving.

Cushion blocks are important

One of the most important details in connection with the driving operation is the cushion block. Generally the best performance has been obtained with 4 to 8 in. of laminated softwood, such as Douglas fir, placed directly between the pile head and the driving helmet. Hardwood blocks have proven unsatisfactory. Plywood cushion blocks are sometimes used, but in more than a few cases these have caused trouble until replaced with thicker laminations of softwood. Cushion blocks should be replaced frequently; once they are fully compressed, they cease to perform their function.

The type of cushion block directly affects the magnitude of the driving stresses. In severe cases, the use of a reduced hammer blow during the soft driving stage may also help.

In one instance, what was originally thought to be tensile cracking was directly traced to torsional stresses induced by the twisting of the pile head in the driving helmet. The solution to the problem in this case was to round the pile head so as to eliminate restraint at the driving head. The pile head should not be completely restrained against rotation.

It has been found that pile hammers with an energy within the limits shown below are usually adequate for driving in the moderate to hard driving range. These values are listed for reference rather than for absolute guidance:

Pile Size, in.	Ft-lb of Energy
10	8,000-15,000
12	15,000-19,000
14	15,000-24,000
16-18	24,000-32,000
20-21	24,000-36,000
24 and over	32,000-38,000

Large-diameter cylinder piles have been driven with hammers having a rated energy up to 50,000 ft-lb.

Properly designed prestressed concrete piles can be used economically for almost all types of foundations,

piers, wharves, mooring and fender dolphins, marine ways, bulkheads, sea walls, and other structures.

When very long piles are used, the problem of handling and transporting may be a critical one. Hollow-core piles can be used to reduce the handling weight; 20-in. octagonal hollow-core piles up to 132 ft long were driven for a waterfront structure in San Francisco.

Applications in marine structures

Where batter piles are used in marine structures in deep water, critical bending stresses may occur during setting and driving when the pile may be cantilevered far below the pile driver leads. A pile with higher prestress or one of greater section modulus may be required.

When the pile tip is to be seated in rock or other hard material, a steel H-pile section may be embedded in the prestressed concrete pile. For example, hollow-core piles 26 in. square, with 14-in. steel H-pile tips, were driven to rock for the foundation of the Petaluma Creek Bridge near San Francisco. The design load on these piles was 200 tons.

Prestressed sheetpiles (Fig. 5) are being used for marine installations where corrosion resistance is important. Since the sheetpile is primarily a bending member, the effective prestress may vary depending on design moments. The efficiency of a sheetpile in bending can be substantially increased by using eccentric prestressing (Fig. 6). Where moment reversals may occur, this is not feasible and somewhat greater concentric prestressing should be used.

The use of prestressed concrete soldier piles for bulkheads, sea walls and retaining walls is another application as a bending member. These piles can be made in the form of an H-section with timber lagging or concrete planks placed in slots or grooves on the sides of the piles, or as square or rectangular members with lagging placed behind the pile. On a graving dock now being built in Alameda, Calif., 20 x 30-in. prestressed soldier piles are being used as a retaining wall for a cut 40 ft deep, (Fig. 7). Mild-steel reinforcing is used for additional strength at the moment peaks, the main reinforcing being provided by the prestressing steel.

Conclusion

While sufficient experience has been accumulated for the proper design, production, driving, and utilization of pretensioned concrete piles, it must be admitted that very little has been done to rationalize the procedures or to analyze the results. If economical applications have already been obtained by sheer experience, it is only natural to expect even better performance with a more refined and scientific approach.

(Since this article was written, a Joint AASHO-PCI Committee on Standard Prestressed Concrete Piles has been formed, with representatives from the Committee on Bridges and Structures of the American Association of State Highway Officials and the Prestressed Concrete Institute. It is understood that standard pretensioned piles of both the square and the octagonal type have been agreed on and the standards will soon be available.)

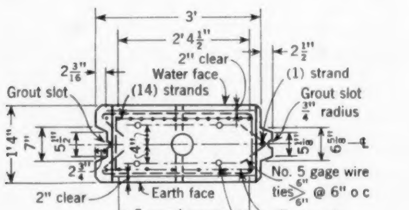
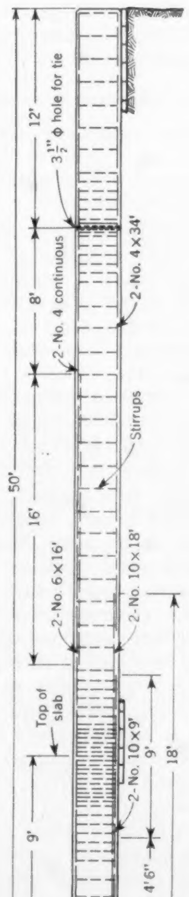


FIG. 6. Sheetpile with eccentric prestressing for a bulkhead wall in Long Beach, Calif. Slight eccentricity does not affect the driving characteristics of the pile.



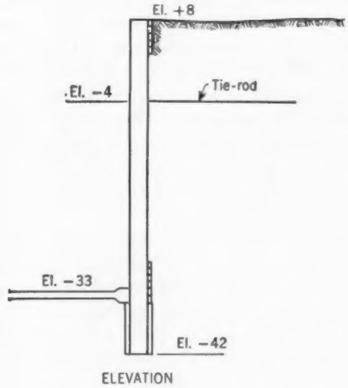
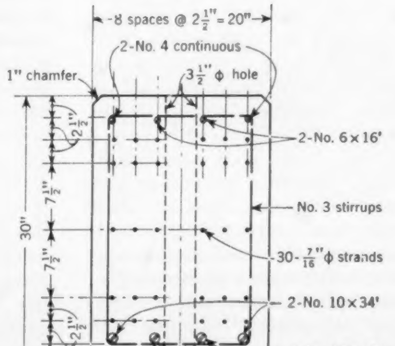


FIG. 7. Soldier piles with reinforced and prestressed steel, to take care of peak moment in different parts of the pile.

SECTION



Corporate practice as defined in NCSBEE Revised Model Law

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Vice Chairman, ASCE Committee on Registration of Engineers
Partner, Gongwer, Kraas & Webb, Washington, D. C.

A Model Law described as "A Guide for the Preparation of Uniform Laws for the Registration of Engineers and Land Surveyors," was adopted by the National Council of State Boards of Engineering Examiners at its annual meeting in Portland, Oreg., on August 18, 1960. As a participating member of NCSBEE, the American Society of Civil Engineers was given the opportunity either to endorse or to disapprove of this Revised Model Law.

At its meeting in Phoenix, the ASCE Board of Direction voted to adopt in principle the recommendations of its Committee on Registration of Engineers for revision of the proposed NCSBEE Model Law. The Committee's redraft of Section 22 (*c*), (*d*) and (*e*) appears later in this article.

By far the most controversial part of this Law is found in Section 22 (*d*) entitled, "Corporate and Partnership Obligations." It reads as follows:

"This Act shall not be construed to prevent or to affect: The practice or offer to practice engineering, as defined by this Act, by individual registered professional engineers, through a partnership, joint stock company, or corporation, as agents, employees, officers or partners, provided they shall be individually liable for their professional acts, and further provided that all personnel of such partnership, joint stock company or corporation, who act in its behalf as engineers in the state are registered under this Act or are persons practicing lawfully or are exempt under Paragraph (*b*) or (*c*) of this Section. Each such partnership, joint stock company or corporation providing engineering services, shall be jointly and severally liable with such individual registered professional engineers, and all final plans, designs, drawings, specifications and reports, involving engineering judgment and discretion, when issued, shall be dated and bear the seals and signatures of the engineers who prepared them."

The controversy is in regard to corporate structures. This controversy is not new. As far back as 1935 the Model Law then in existence contained a provision permitting corporations to engage in the practice of professional engineering under certain conditions. This was eliminated in a later revision of the Model Law and the draft in effect before the August 1960 meeting of NCSBEE contained no reference to corporate practice.

Issue is corporate structure

The arguments of those on both sides of the question of permitting professional engineering practice through the corporate form of organization have been so widely disseminated that a repetition of them here is needless. At one extreme are those with the purely professional viewpoint, who would not permit practice through the corporate form under any conditions; at the other are those who would permit any corporation, as such, to practice professional engineering. It seems logical to expect that a position between these two extremes will ultimately be accepted.

At present there seems to be rather general agreement that engineers should be free to choose the form of organization under which they wish to practice. The problem is not with engineers but with non-engineers who seek to be a part of an engineering enterprise. The best interests of the public and the engineering profession will be served if only engineers are permitted in engineering organizations. It is for this reason that certain restrictions or safeguards are placed on the corporate form of practice. These safeguards are not designed to protect the public against registered professional engineers, whom we must assume are ethical in their dealings, but rather against the possibly unscrupulous non-engineer who seeks to exploit the engineering profession for his own economic gain.

The stand of ASCE

The American Society of Civil Engineers has recognized the fact that a large number of corporations actually do offer and do render engineering services to the general public. ASCE policy has advocated that the protection of the general public be assured by requiring that such corporations satisfy the following requirements (Civil Engineering, November 1957, vol. p. 816):

1. The majority of the officers shall be registered engineers in the state of incorporation.
2. The majority of the directors shall be registered engineers in the state of incorporation.
3. The engineers in responsible charge of the practice of engineering shall be licensed in the state having jurisdiction over the performance of such practice.

It is felt that the restrictions on corporations as set forth in Section 22 (*d*) of the NCSBEE Revised Model Law, quoted above, fail to provide the safeguards that are a part of ASCE policy. While the section deals with the practice of engineering by "individual registered engineers," it clearly implies that other than registered engineers may be included in the personnel of such corporations. The limitation is that those who act in its behalf as engineers be registered engineers or persons practicing lawfully, or who are exempt. Under such a provision it would be possible for a corporation to have only one engineer in its employ. Non-engineers could negotiate contracts, determine the conditions under which the work would be done, reap the profits, hire and fire

the engineer at will and do everything else except the actual engineering work, which would be the responsibility of the engineer.

Such an arrangement is not in the best interests of either the public or the engineering profession. There is nothing that would alert an unsuspecting public to the fact that it was dealing with a group of non-engineers with but a single registered engineer in their employ. The status of the engineer employee in such a situation is obvious. He would be a mere pawn of business. No engineer could tolerate such a condition and still claim to be a professional man.

There is nothing in Section 22 (*d*) that would prevent the names of non-engineers from appearing in the firm name of an engineering corporation. A recent issue of a NSPE publication announced an opinion by the Attorney General of Texas upholding the legality of such a name. In that situation the firm name contained the names of three men, none of whom were registered engineers. Here again, the objection is not to what engineers do but to what non-engineers might be permitted to do under the law.

It is often said that the welfare of engineers or of the engineering profession should not be a factor in considering the provisions of a model law, since the only purpose of, or legal reason for, an engineering registration law is stated in Section 1 of the NCSBEE Revised Model Law which reads as follows, "In order to safeguard life, health, and property, and to promote the public welfare, the practice of engineering in this state is hereby declared to be subject to regulation in the public interest." We feel that we cannot ignore the welfare of engineers or of the engineering profession for it is a well established principle that any policy which tends to degrade a profession is not in the public interest. In accordance with this principle, the comments set forth above are relevant.

Redraft proposed by ASCE

In May of 1960, following a meeting with the NCSBEE Committee that was writing the Model Law, representatives of ASCE, CEC and AICE presented a substitute Section 22 (*d*) to the NCSBEE Committee. This substitute was a compromise and differed slightly from the present ASCE policy but provided safeguards that would provide the protection desired by ASCE. This substitute was not accepted by the NCSBEE Committee for inclusion in the Revised Model Law.

The ASCE Committee on Registration of Engineers has considered this entire question at great length. It proposes the following redraft of Section 22 (*c*), (*d*) and (*e*) of the NCSBEE Revised Model Law:

Section 22. EXEMPTION CLAUSE

This Act shall not be construed to prevent:

(*c*) **Employees and Subordinates**

The work of an employee or a subordinate of a person holding a certificate of registration under this Act, or an employee of a person practicing lawfully under paragraph (*b*) of this Section; provided such work does not include final engineering decisions and is done under the direct supervision of a person holding a certificate of registration under this Act or a person practicing lawfully under Paragraph (*b*) of this Section.

(*d*) **Engineering Corporations and Partnerships**

The practice or offer to practice of engineering, as defined by this Act, by individual registered professional engineers, through a partnership, joint stock company, or corporation, provided they shall be individually liable for their professional acts, and provided further that the partnership, joint stock company, or corporation, rendering such engineering services shall be jointly and severally liable with such individual registered professional engineers; and further provided:

1) The majority of the shares of the corporation's voting stock shall be owned by individual registered professional engineers.

2) A majority of the directors shall be registered professional engineers.

3) All the officers shall be registered professional engineers.

(Amended by ASCE Board of Direction to read: "A majority of the officers, including the President, shall be registered professional engineers.")

4) The individual engineers in responsible charge of the practice of engineering, shall be registered in the state having jurisdiction over performance of such practice.

5) All final plans, designs, drawings, specifications and reports involving engineering judgment and discretion, when issued, shall bear the seal and signatures of the registered professional engineers who are responsible for them.

6) All living persons whose names appear in the name of a partnership, joint stock company, or corporation shall be registered engineers in a state, territory or the District of Columbia.

(*e*) **Non-Engineering Corporations and Partnerships**

Any corporation, partnership, or joint stock company from using its own engineering services to perform work which is incidental to the manufacture or sale of its products, providing such services do not include the furnishing of an overall design of a project.

It will be noted that the words "or to affect" have been eliminated in the first sentence of the above quoted material. It is considered that the Act could not fail to have some effect on all the categories mentioned.

It is considered that this redraft will eliminate the objectionable features of the NCSBEE draft and is in harmony with present ASCE policy in providing the safeguards required by that policy.

The Committee on Registration of Engineers studied this problem with the objective of bringing the NCSBEE Model Law into harmony with the present policy of the ASCE. This has been difficult because in even this small group there is not complete unanimity of thought concerning this problem. It is recognized that there are some large corporations that have been practicing on a highly ethical basis for many years whose non-engineering corporate activities would make it impossible for them to comply with the proposed draft. It can fairly be said, however, that the construction activities of many of these firms overshadow their engineering activities. While construction, particularly heavy construction, involves much engineering, construction is primarily a business, not a profession in the sense that law, medicine and engineering are professions.

The majority must decide

Let me close with a personal observation on policy which does not represent the unanimous thought of the Committee. The policy of the Society, of course, like that of any truly democratic institution, is ultimately determined by the wishes of the majority of its members. Perhaps this is the time to examine it anew to see if it truly reflects the desires of the majority. The advantages of practice through the corporate form, if any, are primarily economic. Is such practice compatible with our efforts in time and talent to raise the status of engineering to a profession?

We must decide ultimately whether we are professional men or business men. This is the fundamental issue. Both are honorable callings and certainly a successful professional man must also be successful in a business sense, but the recognized professions of law and medicine do not permit corporate practice. The public has accepted those callings as professions because of the actions of the individuals who comprise them.

We likewise will be judged by our individual actions. It is what the public thinks we are, not what we call ourselves, that in the final analysis determines our professional status. If we place money above service our professional status is in jeopardy.

(This paper was originally presented by Mr. Gongwer at the ASCE Phoenix Convention, before the session of the Department of Conditions of Practice sponsored by the Committee on Registration of Engineers.)

PLASTIC ANALYSIS

supplements design of aluminum structure

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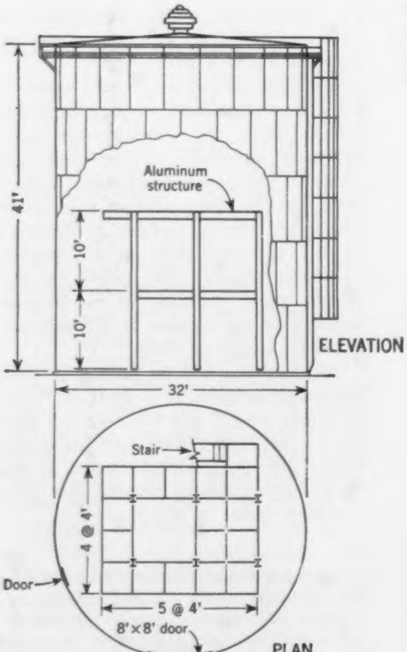
Discussions between proponents of the elastic and the plastic theories of structural analysis are still being added to engineering literature. Actually each method nicely supplements the other in the design of the structure here described, an aluminum framework for a "criticality assembly" experiment for reactor research at the Brookhaven National Laboratory. The 10-ton aluminum structure supports a 60-ton experimental apparatus, one part of which is stationary, the other part movable. The entire structure and experiment are sheltered by a commercial-type grain silo, a prefabricated light-gage steel tank 32 ft in diameter and 41 ft high. See Fig. 1.

The aluminum space frame was first designed in accordance with the customary elastic method of analysis, moment distribution being the basic tool. Plastic analysis was then carried out, the primary purpose of which was to determine the ultimate carrying capacity of the structure. It also helped in searching out the most likely first failure mode, and thus was useful in locating and eliminating any weak points. This dual design resulted in a structure so proportioned that the safe working loads are almost identical whether projected from the allowable elastic stress or from the plastic yield condition. In addition, the plastic design provided a means of quickly checking the structure for the effects of loading schemes different from those currently anticipated.

Future rearrangement of assumed loads is possible in any structure, but in basic research, revisions in loading are almost certain to occur. Built-in safeguards are often the most economical solution. In this case the orientation of columns contributes to uniform lateral resistance in all directions.



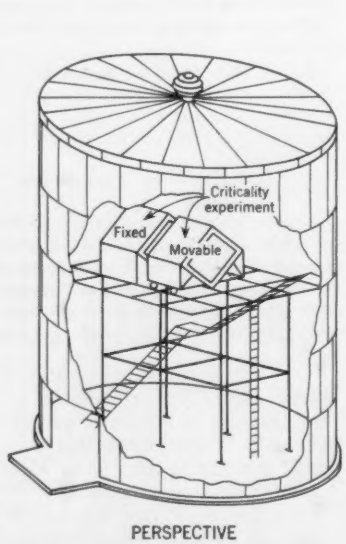


FIG. 1. An all-aluminum structure was used to support the 60-ton weight of a "low-mass criticality assembly" experiment.

Aluminum and steel differ in two basic ways in the plastic range. First, the rupture stress of the moderate-strength 6061-T6 aluminum alloy is only 8.6 percent greater than its yield stress (38 vs. 35 kips per sq in.), whereas for A7 structural steel the same value is 82 percent (60 vs. 33 kips per sq in.). Second, the solution heat-treated and artificially aged aluminum alloy 6061-T6 does not have the pronounced and very beneficial strain hardening or cold working characteristic of A7 structural steel. Although the effects of strain hardening are not normally considered in the plastic analysis of steel, they represent an added safety factor. In aluminum, because of the narrow margin between the yield and the ultimate strength, and because of the limited amount of strain hardening, yielding becomes almost synonymous with total collapse.

Aluminum has a peculiarity also in the elastic range: because of its low modulus of elasticity, the effects caused by the shortening of heavily loaded columns cannot be summarily dismissed, at least as far as heavy rigid-frame structures are concerned.

But aluminum also has its advantages for plastic design. Because of their lower design stresses, structural members of 6061-T6 aluminum alloy are necessarily somewhat more bulky than corresponding steel members, and the limited choice among larger aluminum shapes makes it necessary to build up the required cross-sections. In this case most of the members were built up of beams and channels. They became rather massive and close to the ideal box shape. This is useful in eliminating some of the difficulties often met in the plastic design of steel, namely, the likelihood of elastic, local and torsional buckling.

In this case aluminum was not chosen because of the advantages usually claimed for it as a structural material. Rather, the compelling reasons were its low neutron absorption and scattering cross-sections, which average up to about one ninth of the corresponding values for steel. Cross-

sections are expressed in "barns" (10^{-24} cm^2), and are defined as the relative probabilities of incident neutron interactions with the nuclei of the surrounding materials or targets.

Structural materials with the lowest practicable cross-sections were desirable for two reasons. First, high-energy neutrons tend to reflect from the surrounding walls, floors, equipment and supports, causing serious perturbations in neutron distribution. Disturbances of this kind were minimized by locating the neutron-emitting reactor in the center of the silo building, 20 ft above the floor, on an aluminum supporting structure. Second, neutrons in many cases undergo "capture" within a structural material, creating radioactive isotopes that emit dangerous gamma radiation. This radiation lasts much longer in steel than in aluminum. Because of the low normal power rate of this reactor, neutron flux from the core is very small, and no recognizable degree of damage will result in aluminum, even if the unit is continuously operated for 20 years.

Plastic bending moments and ultimate loads of individual members were calculated on the basis of the mechanism method, the yield strength of aluminum being used in the formulas developed for the plastic design of steel. Safe working loads were obtained by dividing the ultimate loads by a load factor of 2.8, which is the product of the safety factor of 2.33, and the actual shape factor (ratio of plastic and section moduli), 1.2 of both beams and columns.

Elastic design, as well as detailing and fabrication, were in accordance with the ASCE Specification for Structures of Aluminum Alloy 6061-T6 (ASCE *Proceedings* Paper 970, Vol. 82. No. ST 3, May 1956). The structure was cold-riveted in the shop and bolted with 2024-T4 finished aluminum bolts in the field. Bolt-hole diameters were specified to be 1/64 in. larger than nominal bolt sizes, and moment connections were specified to match tightly without clearances. This required some use of force in the field, but resulted in a rigidity approaching that of a welded structure.

Welding was limited to stairs, ladder, handrailing and grating, and was done in the shop only. For increased clamping strength, high-strength steel-bolted moment connections were desirable, but because of the nature of the experiment no steel was allowed in the structure. However, should this requirement be relaxed in the future, the rigidity of the structure, particularly in respect to dynamic loads, can be further increased by replacing about 40 percent of the aluminum bolts with properly tightened high-strength steel bearing bolts. On the other hand, aluminum bolts minimize the probability of galvanic corrosion. Although the structure is indoors, it may become subject to other, though remote, environmental hazards having a tendency to induce galvanic action between steel and aluminum, such as stray currents caused by the extensive wiring for the experiment.

The entire structure was test assembled in the fabrication shop. Test assembly in combination with the light weight of the aluminum members and streamlined construction procedures resulted in field erection in 300 man-hours. This was done without any machinery and inside the confined quarters of the silo. The only accessway was an 8 x 8-ft door at ground level.

The total cost in place of the aluminum structure was $1.53 per lb, of which the erection cost was about 7 percent. This price includes both the heavy structural members and the light miscellaneous units, such as gratings, ladder, handrails and davit. The miscellaneous items made up about 25 percent of the total weight.

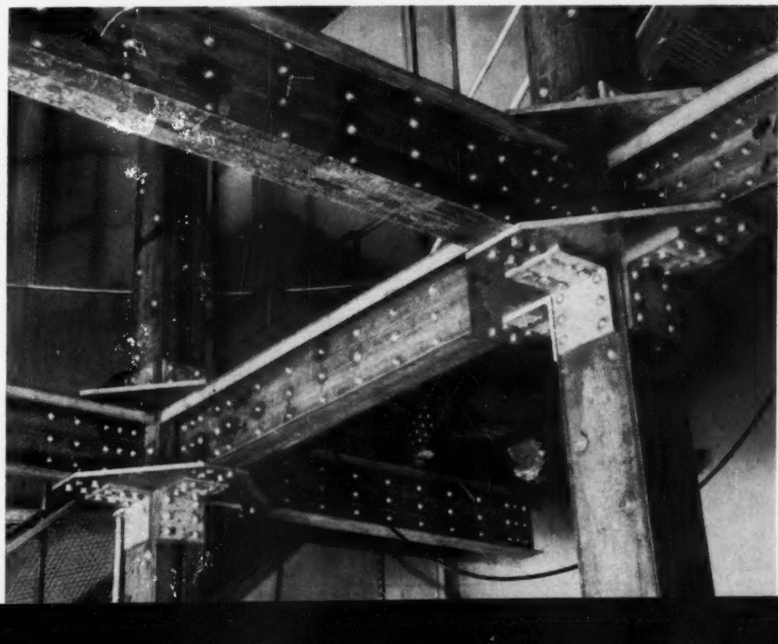
Bid prices showed wide variations. The low bid by the fabricator and erector, Dayton Metal Products, Inc., of The Bronx, N. Y., was 5 percent below the estimate; the others followed, from 2 percent below up to 56 and 62 percent above.

The plastic method with its inherent simplicity, and the elastic method with its long established reliability, contributed their respective merits to the analysis of this aluminum structure. The results were economy and the ability to more closely predict the behavior of the structure under a variety of loading conditions.

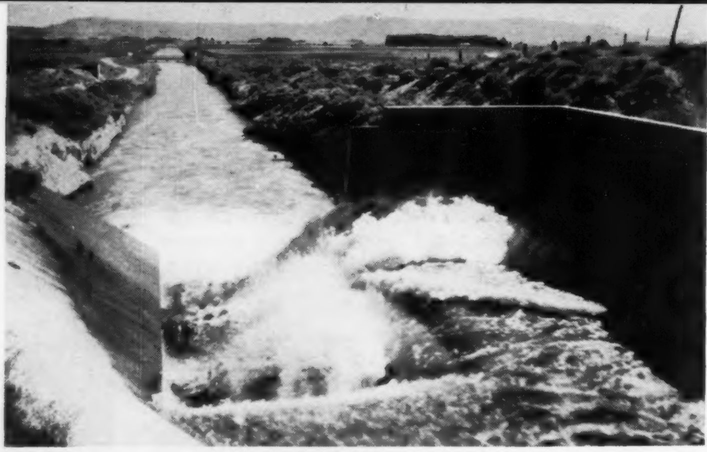
The design work was carried out under the auspices of the U. S. Atomic Energy Commission by the writers. The contract was administered by the Architectural Planning Division of the Brookhaven National Laboratory.

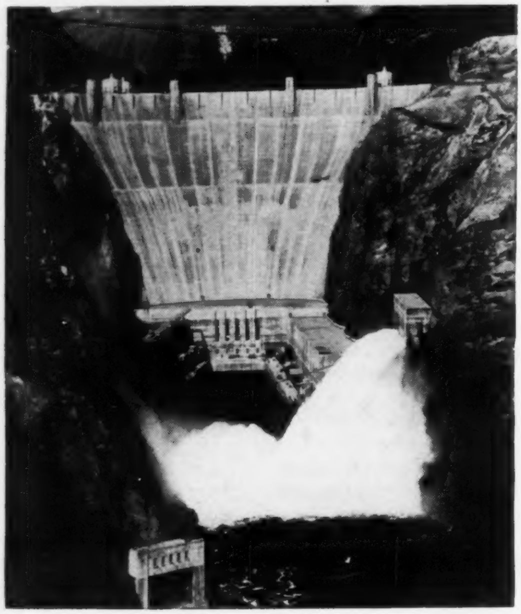
Parts for the 20-ft-high aluminum structure were carried into the sheltering silo through an 8 x 8-ft door and assembled without machinery.

Connections could have been reduced in size if high-strength steel bolts could have been used instead of aluminum bolts.



Air and water play stellar roles in the work of the civil engineer. To the study of these and other "fluids" he must give an effort commensurate with their importance in the global environment. Right: Canal drop on Klamath Project, Oregon and California. Below: Hoover Dam.

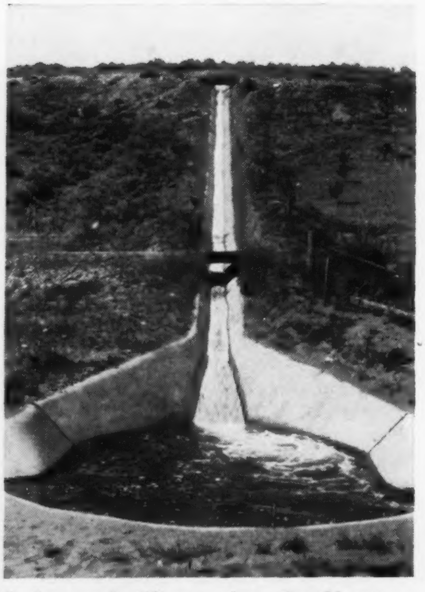




Civil engineering has been aptly defined as the engineering of our land, water, and air environment. If the profession is to fulfill the ambitious function implied in this definition, that of creating the best possible physical framework for human life and activities, it must devote to the study of fluids an effort commensurate with their role in the global environment. This role is not static, but grows rapidly and dramatically with the great advances in those collateral, yet more specialized engineering fields such as mechanical, chemical, naval, aeronautical, and nuclear engineering in which fluids play a large and often preponderant part.

Study of the laws that govern the motion of fluids and of the forces that cause and oppose this motion makes up the realm of fluid mechanics. As

Left: Chicago's West-Southwest Sewage Treatment Plant. Below: Central terminal area of New York International Airport, from roof of tower.



A drop and stilling pool on the Okanogan Irrigation Project, State of Washington.

Fluid mechanics— its scope and challenge

GEORGE BUGLIARELLO, A.M. ASCE, Assistant Professor of Civil Engineering, Carnegie Institute of Technology, Pittsburgh, Pa.

are all scientific disciplines, fluid mechanics is important in two respects: it provides an insight into the workings of nature, and it enables us to utilize nature for the satisfaction of our needs. Although it is primarily in this second aspect, the application of scientific knowledge and experience to the control of our fluid environment, that fluid mechanics is vital to the civil engineer, the two aspects are indissolubly interconnected. Thus we are confronted with a triple task and a triple challenge in basic research, planning and design.

Basic research, the first task

Our first task is to acquire a knowledge of the basic laws of nature concerning fluids, fluid behavior, and fluid resources. It is very fortunate that certain general laws apply to all fluids, be they gasses or liquids. This greatly simplifies the task, making it possible, within limits, to study in a unified manner air and water as well as other flowing substances of different characteristics.

Since in nature fluid bodies are very often subject to and greatly influenced by heat or electric and magnetic fields, thermodynamics and electrodynamics play an important role in the study of flows. This role is heightened by the increasing appreciation of the fact that the motion of a fluid is ultimately the resultant of the motion of a system of molecules, atoms, and ions, each possessing electric and magnetic fields as well as thermal agitation. Electromagnetic flow meters and pumps, hot-wire velocity probes and paramagnetic resonance methods are among the significant new developments in the laboratory and in the field utilizing the interrelationships among electromagnetic, thermal and flow phenomena.

Other sciences concerned with the behavior of fluids in our environment, which are essential to the civil engineer, are meteorology, climatology, hydrology, oceanology, and limnology; they all rely heavily on fluid mechanics.

In the quest for a better understanding of the fundamental phenomena of flow, civil engineers have wandered far afield, investigating problems as diversified as hydromagnetic flows, noise, vibrational problems of ships, basic mechanics of turbulence, flow of blood and other fluids of complex constitution, explosive waves, and supersonic aerodynamics. The results have provided essential information for our professional use, and have also been of tremendous value in other fields of engineering and science, as attested by the strong competition among industries, government and academic institutions to employ, in the most disparate areas, civil engineers with a good training in fluid mechanics.

Strategy in planning, the second task

Our second task is the formulation of the general approaches to the utilization of the fluid resources in our environment. This task can be called one of strategy or planning. Here basic knowledge of fluid phenomena is brought to bear on the utilization of the environment within the limitations and demands imposed by other environmental factors.

In combination with economic, social, political, and other technological considerations, plans are made for the location, design characteristics, and operation of harbors, airports, pipelines, and water treatment plants; also for the development of river basins and for the protection of cities from air pollution. Putting bacteria to work in water treatment plants and providing controlled conditions for the raising of fish in inland waters are but two instances of methods for effectively utilizing the bacteriological and biological components of our environment. It is indeed here, in the harmonization of fluid mechanics and biological factors, that our profession can claim to be the first branch of engineering to point the way to that biotechnical age which Lewis Mumford predicts will be the next phase in the progress of civilization.

What has been fittingly termed thermal pollution offers an example of the problems encountered in planning the utilization of a fluid resource. With the growing expansion of thermal power plants, one of the paramount necessities has become the finding of large quantities of cool water for the condensers. And seldom can a body of water be used for only one purpose. Thus, from planning for the limited objective of finding cheap and abundant cool water, the problem becomes one of satisfying a host of conflicting demands.

An excellent illustration of the importance of planning in water utilization is cited by David Lilienthal in an analysis of the current struggle between India and Pakistan for the control of the waters of the Indus. He points out that a coordinated scheme could double the present utilization of the river, thus eliminating the technical grounds for the controversy.

Tactics in design, the third task

Our third task can be called one of tactics, that is, the detailed study, design, and execution of the devices required to carry out the general philosophy of fluid resources utilization. Here the task of the civil engineer is to construct the most effective devices for storing and containing fluids (such as dams and levees), for conveying fluids and fluidized materials (pipelines, canals, smokestacks), for traversing fluid bodies or for assisting in traversing them (harbors, airports, bridges), for controlling fluid bodies (breakwaters, spillways, wind deflectors, settling tanks), for extracting energy from fluid bodies (hydroplants, wind generators, thermal gradient generators), and for their biological utilization (biofilters, fish ladders, sewage lagoons).

Even in structures not directly concerned with the utilization of our fluid environment, the importance of

fluid mechanics to the civil engineer cannot be sufficiently stressed. Much too often a high degree of sophistication in the structural design of a bridge is matched by rudimentary assumptions regarding wind loads and the interaction between river and piers. If the failure of the Tacoma Narrows Bridge is a dramatic reminder, there are many other less publicized cases in which neglect of fluid mechanics factors has resulted in inadequacies, failures, or expensive overdesign.

Many challenges ahead

What has been accomplished so far is but a pale image of the challenges awaiting us. Whatever the area in which the civil engineer specializing in fluid mechanics may choose to exert his effort, he is faced with tasks as exciting as those confronting scientists and engineers in other fields, and even more important for the ultimate welfare of the species.

In basic research, one of the most difficult and fundamental problems is that of bridging the transition between flow phenomena on a molecular scale and on a macroscopic scale. There is an intermediate region between these two scales, into which, today, neither the molecular nor the macroscopic approach can reach. Yet this region, we suspect, has a fundamental importance in a great many fluid processes. We need a theory and we need experimental techniques for studying flows on this scale.

More directly related to our immediate needs is continued research in the causes of flow separation around bodies immersed in a fluid (stall), in means for reducing drag, and in the mechanics of diffusion. These are problems of tremendous practical importance.

Control of flow separation would lead, for example, to the attenuation of stream-induced structural vibrations, to more efficient design of flow passages, and to improvement in localized silting and erosion phenomena in rivers.

Drag reduction would bring about tremendous savings in the staggering amount of energy expended throughout the world in conveying fluids through all sorts of channels and in moving objects through fluids. The reduction could also be beneficial in cutting down one of the major agents of erosion by winds and streams and in decreasing the strong fluid-dynamic forces acting on tall structures.

The filling of large gaps in our knowledge of the many-faceted mechanism of diffusion would make possible far more effective control over the transport of matter and heat by fluids, the mixing of fluid bodies, the characteristics of turbulence and, in turn, of stall and drag phenomena.

Among the many other problems clamoring for our attention, and becoming more pressing as civil engineering extends its scope, are a better knowledge of waves and their effect on structures and coastlines, as well as a study of the characteristics of flows under very large pressures, such as those encountered at the bottom of oceans.

Finally, the design of fluids has been given little attention until now. As our knowledge of the relationship between fluid structure and fluid behavior deepens, we should attempt to tailor a fluid to a given boundary configuration in order to obtain a specific result, rather than tailoring the boundary to the characteristics of the fluid. This problem, of paramount significance in many fluid mechanics applications, is parallel to that toward which much effort is being directed today in solid state physics.

In basic research much benefit can be derived from an analysis of biological systems. These systems make extensive use of fluid mechanics processes and challenge us to match their efficiency in the combination of high heat transfer and low drag observed in the capillaries, in the accurate and extremely sensitive regulation of flows, in the supply of liquid nutrients to the cell as well as in numerous other functions.

Planned utilization of resources

In the area of planning, there is the need for more vigorous and scientific approaches to the problem of the best global utilization of all fluid resources. A clearer understanding of the interrelationships between all the components of our fluid environment is necessary for the formulation of comprehensive plans in which each component is utilized in the best possible way without impairing the other. Advances in the knowledge of these basic laws of the fluid environment on the one hand, and of the interplay of economic, political, sociological, and geographical factors on the other, will supply us with an increasingly rational basis for planning.

Until now, the scope of planning has been primarily confined to the resources available in a given region. In the future, however, the development of more powerful techniques, such as atomic explosions, should provide means for altering or controlling the distribution of fluid resources on a much larger scale. We are already alleviating droughts by transferring water from one large water basin to another; we are experimenting with the artificial creation of rain. Among the more gigantic and exciting tasks to which we should turn next is the control of sea and air currents. By diverting sea currents, we could alter the climate of entire regions; on a smaller scale, we could reduce the silting that impairs the efficiency of harbors, or improve fishing conditions. Similarly, by controlling air currents, we could influence the climate, air pollution, and other environmental factors of cities, farms, airports, and even larger areas.

The large arid regions seen on a map of the world challenge us to find ways to convert them to productive use. Here atomic energy could help in blasting canals and reservoirs on an unprecedented scale. Also, atomic explosions could open new harbors and new navigational waterways. The impact of these ambitious and demanding enterprises on the world economy, geography, and population would dwarf the achievements of all the preceding technological revolutions.

Problems at the tactical level

Innumerable problems challenge us at the tactical level. How to skim the cooler layers of a stream; to control the meandering of rivers or the smoke carried by winds in an industrial area; to flush the sediment accumulated in a reservoir; to reduce the impact of nuclear blasts on structures and deflect fallout; to speed up the self-purification of a stream; to convey large quantities of solids and even people through pipelines; to better utilize the great stores of groundwater; to improve the navigability of rivers; to quell or put to use waves; to devise techniques for controlling large fluid bodies in nature; to meet the problems of the fluid environment on other planets open to us by space exploration—these are some of the challenges that face engineers.

To the extent that we can meet this triple series of challenges—in the drafting room, the construction yard and the university—we shall retain the right to the responsibility and the pride which the definition of our professional purpose implies. Our responsibility is not confined to the design of a canal, a dam or a bridge. These are only limited and perhaps transitory aspects of the essential task of shaping our environment into the connective tissue of civilization—a task in which fluid mechanics plays so basic a role. If we fail in this task, all the other achievements of our age will be meaningless, and our civilization itself will ultimately fail.

Illinois Radio Telescope
—unusual tool for space research

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JOHN C. CASSON, M. ASCE, Associate, Walter E. Hanson & Company, Springfield, Ill.

Ingenuity and engineering knowledge have been combined in the joint efforts of civil and electrical engineers to produce the large and unusual radio telescope now nearing completion at Danville, Ill. Modern civil engineering techniques and materials have been employed to meet the rigid requirements of this high-performance electronic tool.

The radio telescope is a device that gathers radiation from distant celestial objects. Functionally it is similar to an optical reflecting telescope. Both instruments employ reflecting surfaces which focus or concentrate the received radiation in such a manner that it can be observed in some intelligible form. The radio telescope utilizes an antenna system at the focal point. Operating within the radio spectrum, where the wave lengths are many times longer than those which produce light, powerful radio telescopes require extremely large reflectors.

The Illinois instrument has no movable parts but, by a unique system that utilizes electrical ingenuity to swing the antenna beam in the meridian plane, it will be able to study a given celestial source as the earth's rotation brings the object into view.

The Illinois Radio Telescope has a fixed parabolic reflecting surface 400 ft wide, 65 ft deep and 600 ft long, an area larger than four football fields. The focal line or axis of the parabolic cylinder lies along a true north-south line. The focal length of the parabola is approximately 155 ft. The reflecting surface is composed of welded wire fabric (2 in. x 2 in., 16-gage wire) placed over an asphalt plank liner The receiving antenna elements are supported along the focal line of the parabolic surface beneath timber trusses supported by timber towers. Four towers, 165 ft high, are spaced 150 ft on centers. The width of the entire timber structure was held to only 4 ft 8 in. The unusual proportions of this structure were made possible by utilizing 16 steel-strand guys.

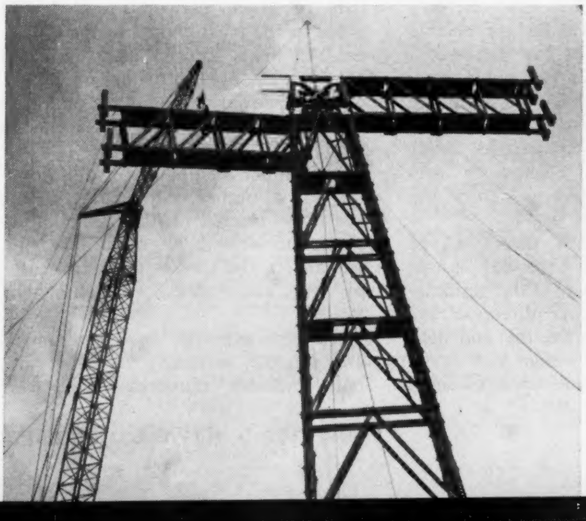
Design studies

Preliminary studies conducted by personnel of the University of Illinois established the proposed function of the instrument and indicated minimum requirements for reflector size and other operational criteria. After considerable investigation, a small valley near Danville, Ill., was tentatively chosen as the site. Suitable topographic characteristics and relative freedom from radio "noise" qualified this location in these two very important respects.

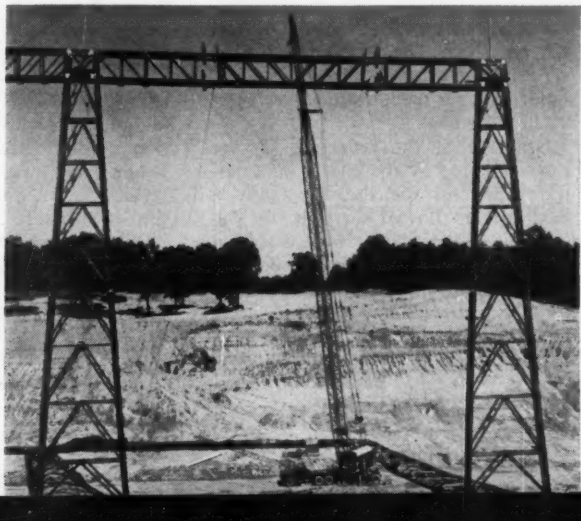
The firm of Hanson, Collins and Rice, Inc., Springfield, Ill., was authorized to begin feasibility studies and preliminary design for the structural and civil engineering aspects of the project. First, a program of subsurface exploration and soil testing was initiated. The results of this program confirmed the suitability of the site from this important standpoint.

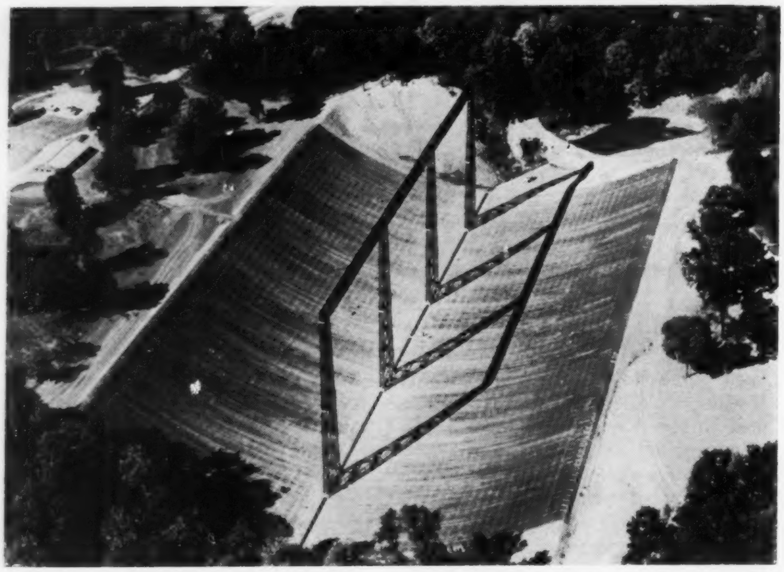
Factors such as the desired useful life of the instrument (15 years), a limited research budget, and the desire to eliminate a maximum number of electrical interference characteristics, greatly influenced the design criteria. To minimize interference, for example, the structure that supports the antennas had to be as narrow as possible. Numerous structural systems were considered that would provide a semi-rigid support at the antenna line 155 ft above the ground and yet be of minimal dimensions. A guyed timber structure with a minimum number of metallic connections was finally chosen as the most suitable. The final structure incorporates plastic-impreg-

Stub end of truss nears final position. Stub to right has been attached. Note gin pole and temporary guy cables. Also note metal straps that are continuous across the top of the tower and are attached to the upper chords of the stubs.



Center truss section of end bay, the last section to be raised, is seen almost in final position. Seventeen working days elapsed from the time the first lower piece of a tower was set until final closure in mid air.





Modern civil engineering contributed to space research in the design and construction of this powerful radio telescope at Danville, Ill.

nated wooden bolts but relies on the superior strength and elastic properties of steel bridge-strand guys.

University astronomers considered it necessary that the instrument be continuously operable through 48-hour periods of average weather. This requirement was interpreted to limit the maximum horizontal and vertical deflection of the supporting structure, at the antenna level, to 2 in. when the structure is subjected to a 40-mph wind load combined with a 20-psf snow load. The sizes of the structural elements chosen on the basis of stress considerations are adequate to withstand the rigors of a 70-mph wind combined with snow load. Conventional factors of safety with respect to static loads were used throughout the structural design.

Close tolerance of reflecting surface

The tolerance of the reflecting surface proved to be another unusual aspect of the operational requirements. Variations in the elevation of the final surface from the theoretical grade were limited to plus or minus 0.10 ft, requiring rigid specifications and careful field control.

Drainage of the reflecting surface was facilitated by the choice of a natural valley for the site. Originally a small stream flowed through the valley. This stream was redirected so that it now flows down the center of the instrument in an open concrete channel 2 ft 6 in. wide and 4 ft 0 in. deep. This channel is continuous through the tower footings. The entire instrument is sloped at 2 percent, which approximates the original natural fall of the valley. A small dam was placed above the instrument to pond high-frequency storms and confine them to the channel. Statistically, storm water with a recurrence interval of five years should be confined to this channel. The flow on the reflecting surface from storms of greater magnitude should not be damaging.

After the valley had been cross-sectioned, a number of parabolic sections were tested to determine which shape would most effectively balance the earthwork. When the position of the most suitable center line had been determined, an economic study involving the height of the timber structure versus various parabolic sections was made. Within the range of parabolic sections that most nearly provided balanced earthwork, varying the focal length changed the height of the structure and the shape of the parabolic cross-section. Such a change influenced the cost of the structure very little; however, it had an appreciable effect on the cost of the earthwork. Consequently, when a parabolic cross-section was found that minimized the amount of earthwork, it was the section chosen. The compatible tower height was within electrically prescribed limits, and final design of the timber structure was begun.

In the north-south direction the timber structure is a three-bay frame, statically indeterminate to the ninth degree. In the east-west direction the towers are guyed at the top and near their midpoints. The design load of the receiving antennas and appurtenances was assumed at 10 lb per ft; consequently, wind and loads due to guying controlled the size of members governed by stress. In the north-south direction, analysis was by means of column analogy and moment distribution. In the opposite direction the towers were treated as columns supported by non-linear springs at the guy points.

After static analysis and the selection of preliminary sizes for members, a check was made on the dynamic stability of the entire tower and truss system. For wind in the east-west direction the system proved to be dynamically stable. For wind in the north-south direction, however, the critical wind velocity for the original structure was indicated to be approximately 20 mph. Exposure to the wind of the contemplated solid plywood bracing, on the north and south faces of each tower, would have resulted in the formation of vortices. Computations indicated that these vortices would twist the towers and that this twisting would in turn cause the relatively light trusses to oscillate.

This deficiency could not be corrected by a variation in guy arrangement at the tops of the towers. It was estimated that the guy arrangement contributed approximately 20 percent to the torsional resistance of the towers. Widening the towers would stiffen the structure, but besides being a detriment electrically, the increased area exposed to the wind would tend to increase the excitation forces. To illustrate the severity of the condition, the *EI* of the tower section would have had to be increased approximately four times to raise the critical wind velocity to 45 mph. The situation could best be relieved if the solidity ratio of the areas exposed to the wind could be reduced by approximately one-half. This was accomplished by the use of a lacing system which replaced the solid plywood bracing.

Surfacing for the cylinder

Lateral bracing for the trusses consists of ¾-in. plywood, nailed and glued to the truss chords to form girders. All truss chords are laminated Douglas fir 4½ in. wide by 11 in. deep. All tower legs and the members at the tops of the towers are laminated Douglas fir 6½ in. by 11 in. The rest of the timber members are solid nominal stock lumber. All members were pressure treated with pentachlorophenol to an 8-lb retention. The timber towers and trusses were fabricated by American Fabricators, Bellingham, Wash.

To determine the most economical and suitable surfacing for the parabolic cylinder, numerous types were

investigated. All surface treatments considered were electrically unsuitable as a reflecting surface and required a covering of wire mesh. Finally, two types of surfacing, soil cement and asphalt liner, were included as alternates in the bidding documents. These surfaces were chosen primarily because of their low first cost. The lowest bid received was based on the asphalt-liner surface and was accepted.

The asphalt-liner surface is composed of planks ½ in. thick, 3 ft wide and 15 ft long. Where the slope of the parabolic surface exceeds 3:1, the planks are attached to the earth surface with two 10-in. spikes. Washers of 3-in. diameter were placed under the head of these spikes. Two more spikes were added to each plank when the slope exceeded 2:1. Gussets ¼ in. thick, 6 in. wide and 4 ft long were attached along each east-west joint at 7½ ft on centers. Solid gussets were used near the top and over the berm. Solid gussets were not used over the remainder of the surface as it was thought desirable to have a means of egress for trapped water. However, to prevent washing, the majority of the remaining joints between the planks were filled with hot asphalt.

Earthmoving in a small area

Earthmoving operations were hampered by the terrain and a relatively small working area. Part of the underlying soil is a thinly bedded shale. The specifications classified this material as earth excavation because it could be loosened by a ripper. This material made an excellent fill when properly mixed with other suitably graded materials. At one point where the completed fill had to be excavated to receive a guy anchorage, a jackhammer had to be employed since hand methods were inadequate.

Earthmoving consisted of three operations. The first operation, or rough grading, consisted of moving and compacting the materials. Portions in fill were overbuilt 0.3 to 0.4 ft, and portions in cut were left 0.3 to 0.4 ft high, if the material met density requirements. Otherwise, these areas were undercut a minimum of 2 ft and recompacted. The second operation consisted of trimming, or fine grading, to the approximate theoretical elevation. The final operation consisted of hand preparation of the soil immediately preceding the placing of the asphalt plank.

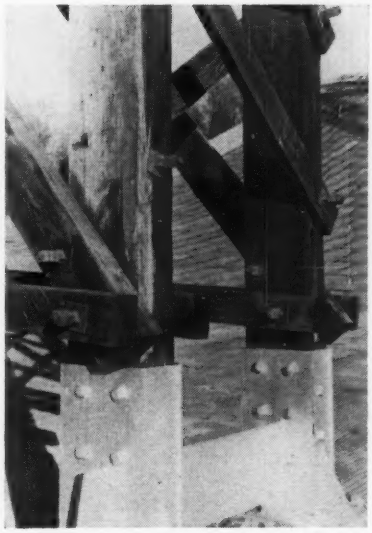
Various methods were tried for trimming the surface to the required tolerances during the second operation. The most successful utilized two motor patrols working together and interconnected by a steel cable. The cable ran from one patrol, up the slope, through a block attached to a tractor on the berm, and then down the slope to the other patrol. The tractor moved along the top of the berm and served as an anchor.

Final preparation of the soil consisted mostly of hand work to bring the earth surface to final elevation. Pins set to theoretical elevation were placed 50 ft on centers in the north-south direction and 10 ft on centers in the east-west direction, or along the parabolic cross-section. The variation between the true parabolic curve and the resulting chords was very slight and well within the required tolerances. The soil was then trimmed and raked to conform to a surface approximately ½ in. below theoretical elevation and the soil sterilent was added. The asphalt liner was then placed on top of this prepared soil. Next the spikes were driven and the gusset plates added.

Tower erection

Erection of the timber structure proceeded relatively quickly. The towers and trusses were subassembled on the ground in two and three sections respectively. After the towers were erected, the stub ends of the trusses were placed in proper position near the top of each tower. At the top of each tower, a gin pole and cables with take-ups were installed. The arrangement was such that the ends of the stubs could be moved vertically upward. Temporary guys from the ends of the stubs to the guy anchors provided horizontal control. The remaining part of the center truss was erected next, and then the center parts of the two end trusses. Seventeen working days elapsed from the time the first lower piece of a tower was set until final closure in mid air.

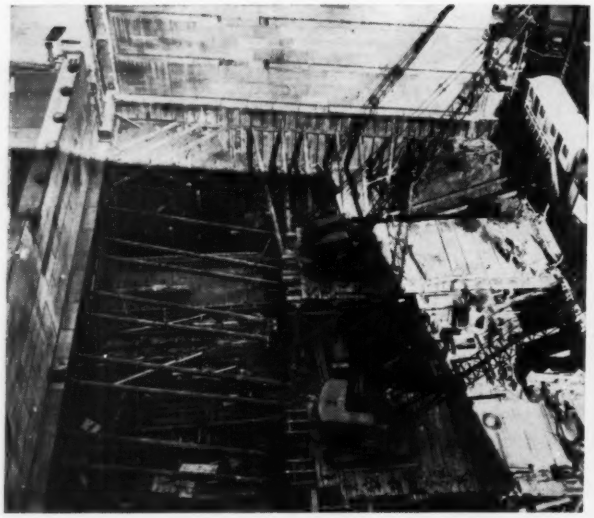
That part of the timber structure above the focal line was assembled using split rings and steel bolts. Parts below the focal line, however, and this included the majority of the tower connections, were assembled using split rings and Permali rods and nuts. Permali is a trade name for a material composed of thin veneers of wood impregnated with plastic and then bonded together by heat and pressure. Rods of this material were used in lieu of steel bolts because of the electrical interference problems that were anticipated with steel. The specifications provided that the towers were to be completely subassembled using steel bolts. The purpose of this was to fully draw up the joints. Each joint was then clamped and, one at a time, the steel bolts were removed and replaced with the final Permali rods. The contractor elected to change these bolts in the air after the towers had been erected.



Steel "shoes" on the tower legs provide termite protection and transfer heavy loads to the footings.

The estimated cost of this project, including the necessary electrical installations, should not exceed $500,000. Chism & Miller, Inc., Springfield, Ill., and W. B. Clements Company, Wellington, Ill., were the joint contractors for the civil engineering and structural work. The contract price for the work now completed, which includes all civil and structural parts of the project, was $312,000. This work was completed in the fall of 1960. Electrical components are tentatively scheduled to be installed late in 1961.

Hanson, Collins & Rice, Inc., consulting engineers, Springfield, Ill., were responsible for all civil and structural design and supervision of construction. The project was under the immediate direction of R. Dean Collins, A.M. ASCE. John C. Casson, M. ASCE, was responsible for most of the design, and Robert E. Gates, A.M. ASCE, represented the firm as resident engineer. Dr. John E. DuBurg, now with the Langley Research Center, National Aeronautics and Space Administration, served as special consultant on aerodynamic aspects of the structural design. The project, which is owned by the University of Illinois and sponsored by the Office of Naval Research, U. S. Navy, is under the direction of Dr. G. C. McVittie, Head, Department of Astronomy, University of Illinois. The University's project engineer in charge of electrical design is Dr. G. W. Swenson, Jr.



Cylindrical struts support cofferdam walls of Z-piles for foundation of 28-story office building. Timber trestles are for the cranes that handle excavation and concreting of footings.

One end of the prefabricated pipe raker struts was welded to the steel wale on the MZ 38 Z-piles while the lower end was heeled against the footing core at the center of the cofferdam.

Z-pile cofferdam for New Orleans' tallest building

T. C. BRUNS, F. ASCE, Chief Engineer, Keller Construction Corp., New Orleans, La.

A system of steel-pipe raker braces for a Z-pile cofferdam cut time and costs on the deepest foundation so far constructed in New Orleans, La. The special features of the cofferdam that accomplished this saving in time and cost were the pipe braces, 16 in. in diameter and 37 to 50 ft long, and the walls of MZ-38 steel Z-piling used without the site-obstructing lateral stiffeners normally employed with standard H-beam rakers of such length.

The cofferdam was designed by Keller Construction Corp., New Orleans, subcontractor for this foundation for New Orleans' tallest building, a 28-story corner office structure at 225 Baronne Street. The foundation is 25 ft deep, 133 ft wide, and 165 ft long.

Cylindrical struts with 3/8-in. and 1/2-in. walls were chosen because their section modulus offers high buckling resistance in all directions, whereas H-beams would require intermediate support in one direction.

Job sequence carefully planned

Each step was carefully planned, from the driving of Z-piles to the installation of pipe struts. The sequence went like this: first, interlocking Z-piles, rented from the L. B. Foster Company, were driven around the entire site and the area was then excavated to 6 ft below street level. Next foundation piles were driven for support of the building, followed by the installation of permanent steel wales. After the center of the site had been carefully excavated to 18 ft below street grade, temporary lightweight steel sheeting was driven at the center, and ten central footings of the 44 permanent building footings were concreted. It was at this point that the cylindrical raker struts were installed between the wale and this center footing core or buttress.

The entire site was excavated to 25 ft below street level, the predriven piles were cut off, and the remaining footings were concreted. No two footings adjacent to each other were excavated at the same time.

Z-piles driven

The job started with the driving of the MZ-38 interlocking steel Z-piles, 40 ft long, by Vulcan No. 1 and McKiernan-Terry 9B3 steam-operated hammers handled by Koehring 1½-cu

yd, 605 cranes. Piles with the highest available section modulus were used to eliminate the need for a bottom or second wale.

Individual Z-piles were driven between a pair of 14 x 14-in. temporary timber guide wales, 36 ft long, pinned to the Z-piles at one end and to the ground at the other to assure alignment. After 36 lin ft of wall had been driven, these guide wales were unclamped and moved ahead for the next 36 ft of setting and driving.

When the Z-piles were driven, one foot of pile was left extending above the street level to prevent inundation of the excavation during rain storms, which occasionally flood downtown streets. After all the Z-piles were driven, the contractor excavated the entire site to a level 6 ft below the street.

On an earth-fill ramp extending down from the tops of the Z-piles, the Raymond Concrete Pile Division of Raymond International brought in a pile-driving rig to drive 750 Raymond cast-in-place concrete piles. Pile shells 77 ft long were driven so that their tops were flush with the ground but they were filled with concrete only to the final cutoff elevation. Concrete was poured to a point about 23 to 25 ft below the street level to form permanent concrete piles 60 ft long.

After Raymond had completed the cast-in-place piles, Keller Construction began installation of 16 WF 58 steel wale sections 4 ft 5 in. below street level along all the Z-pile walls. Each 17-ft wale section was supported on steel brackets previously fastened to the Z-piles.

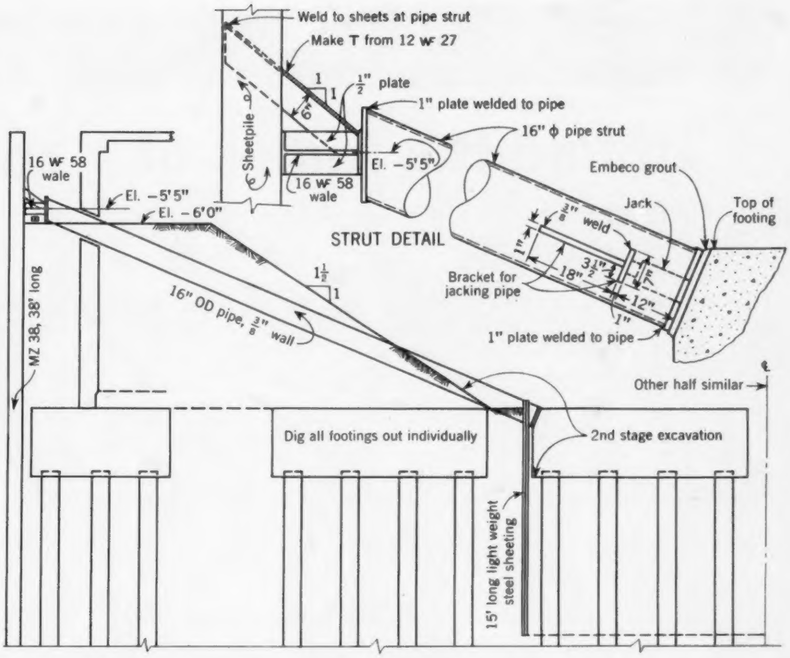


FIG. 1. Stage construction was used for economical excavation of basement area for New Orleans' tallest building. Stage 1 was general lot excavation to El. —6. Stage 2 cleared center for core concrete and Stage 3 complete the operation.

Bracing core formed

With the wale sections installed, the contractor started excavating the entire area. The objective was to provide a concrete-footing core at the center of the site against which to buttress the heels of the pipe raker struts and at the same time provide adequate support for the cantilevered Z-piles. The contractor achieved this objective by shaping this preliminary excavation like a shallow funnel. The funnel opening, or center, was excavated 18 ft below street level with the sides sloping up to the Z-piles, just below the wale.

Lightweight sheetpiles were driven 15 ft into the ground around the 10 center footings. These footings, in two rows of five footings each, vary in depth from 6 to 7 ft. The Foster lightweight sheeting was left in place after these footings were completed.

A concrete ring wall was placed full depth between the 10 central footings to tie them structurally into a rectangular concrete core measuring 32 x 86 ft. Chamfers were formed around this foundation base to house a pair of hydraulic jacks used in positioning each 16-in. pipe raker strut. These chamfers were located near the top of the concrete core in order to reduce the slope of the struts between the Z-pile wale and the footing core. See Fig. 1.

Two steel shark-fin brackets were welded on the sides and near the bottom of each pipe strut. At these brackets a pair of jacks was used to force the pipe strut firmly against the cofferdam wale. The jacks were removed after Embeco non-shrinking grout had been placed between the base plate of the pipe strut and the footing. Spacing of the pipe raker struts varies but alternates between 12 ft and 7 ft along each wall to best support the horizontal wales and permit easy excavation.

To eliminate sloping raker struts at the four corners of the excavation, the contractor positioned horizontal pipe struts between the wales. At three corners there were two diagonally placed struts, while at the one interior corner bounded by two existing buildings there were three.

In addition to supplying the heavy Z-piles and lightweight sheetpiles, L. B. Foster fabricated all the 16-in. pipe raker struts. Each piece was made to exact length—according to the contractor's specifications and drawings. Pieces were then numbered for identification and delivered in sequence to the job site as required.

Keller built two timber trestles to support the cranes handling the excavation and concreting of footings. A Link-Belt crane with an 80-ft boom and an Insley crane with a 70-ft boom worked off these falsework trestles, built at street level, and were capable of reaching any location within the cofferdam. The two falsework trestles were joined by a cross trestle.

More than 17,000 cu yd of material, mostly clay, was removed to permit installation of the 44 footings, which vary in size from 10 x 10 ft to 18 x 42 ft. With the footings in place, Keller began forming and concreting the perimetric building walls up to the first floor at street level. "Windows" were formed in these walls during construction to permit the passage of the raker pipe struts.

After the basement walls were brought up to street level and the first-floor slab was poured, backfill was placed between the walls and the Z-piles. The pipe struts were then cut for removal. Z-piles were left in place to prevent any movement of the ground.

The author designed the cofferdam for the Keller Construction Corp., New Orleans, La. The Crane Construction Co., Chicago, Ill., is the general contractor for the building's owner, the Mac Corporation. The architects are Shaw, Metz & Associates, Chicago, Ill., and the structural engineers are A. W. Thompson & Associates, New Orleans.

ENGINEERS' NOTEBOOK

To find the radius of a curve

A. KAGAN, Civil Engineer, Engineering Department, City of Rock Island, Ill.

The problem here discussed is how to find the radius of a curve when the length of the chord and the length of the arc are given. See Fig. 1. Let

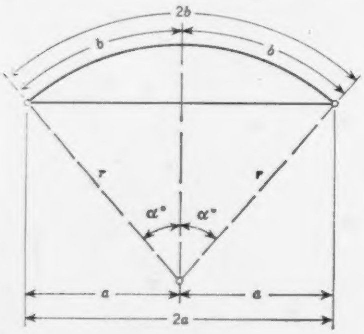


FIG. 1

$2\ a$ = length of chord, ft
$2\ b$ = length of arc, ft
r = radius of arc, ft

By bisecting the angle which subtends the chord and its arc it is seen that

$$a = r \sin \alpha \qquad (1)$$

$$b = \frac{\pi r}{180^\circ} \alpha = 0.17455\ r\ \alpha \qquad (2)$$

$$\text{or } r = \frac{b}{0.017455\ \alpha}$$

$$a = \frac{b}{0.017455} \times \frac{\sin \alpha}{\alpha}$$

$$\text{Or } 0.017455 \times \frac{a}{b} = \frac{\sin \alpha}{\alpha} \qquad (3)$$

For each value of $0.017455 \times \frac{a}{b} = \frac{\sin \alpha}{\alpha}$, find the corresponding angle, α, in Table I. For example, consider the following problem.

$2\ a = 15.52$ ft, $a = 7.76$ ft
$2\ b = 15.70$ ft, $b = 7.85$ ft

$$0.017455 \times \frac{7.76}{7.85} = 0.017255 = \frac{\sin \alpha}{\alpha}$$

$$\alpha = 15^\circ, r = \frac{7.76}{0.25822} = 30 \text{ ft}$$

Of course Eq. 3 can be used equally well to determine the length of the arc if the angle α and the length of the chord a are known. The table for $(\sin \alpha)/\alpha$ can be developed easily for fractions of a degree, that is, for minutes and seconds.

TABLE I.
Values of sin α and (sin α)/α

α°	$\sin \alpha$	$(\sin \alpha)/\alpha$
10	0.17365	0.017365
11	0.19081	0.017346
12	0.20791	0.017326
13	0.22495	0.017304
14	0.24192	0.017280
15	0.25882	0.017255
16	0.27564	0.017228
17	0.29237	0.017198
18	0.30902	0.017168
19	0.32557	0.017135
	etc.	

Culverts designed from curves

EUGENE S. THOMAS, M. ASCE
Engineer, Norfolk & Western Railway
Roanoke, Va.

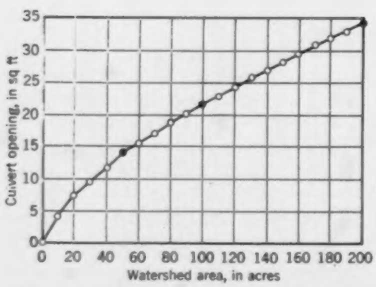


FIG. 1. Relationship of culvert opening to watershed area is plotted. Results obtained by Wentworth formula are shown as small circles, those obtained by Marston formula as solid black dots.

In making preliminary surveys for a drainage structure at a particular location it is necessary to determine the area of the watershed (acres), the slope of the land and other topographical or geographical features as well as the proposed culvert slope and probable concentration time. From an evaluation of this information the culvert is designed.

The writer has prepared a graph showing the relationship between two familiar formulas for a given set of conditions. The curve (Fig. 1) shows the culvert openings in square feet for given watershed areas in acres. The curve is based on the Wentworth formula $a = A^{3/4}$, where

a = required culvert opening in square feet
A = watershed area in acres

Following are the assumptions made in plotting Fig. 1. The drainage area is between 0 and 200 acres; the rainfall intensity is 3 in. per hour; the culvert slope, 0.003 (flowing full); and the percentage of runoff, 33 percent. Furthermore it is assumed that the time of concentration and the associated rainfall intensity are constant for areas of all sizes up to 200 acres and that the velocity of flow through the culvert is determined by the size and slope of the culvert. The comparison is not valid for other culvert slopes.

The results on the curve given in Fig. 1 were compared with similar results obtained from the Marston for-

mula, which states that $Q = ciA$. In this equation:

Q = runoff in cu ft per sec
c = percentage of runoff
i = rainfall in inches per hour
A = watershed area in acres

The results from this formula are shown on the curve in Fig. 1 as solid black dots.

In using the Marston formula, once Q is found, the curves in Fig. 2 were used to determine the culvert diameter needed. This was changed to area and plotted on Fig. 1 (black dots). This Fig. 2 originally appeared as Fig. 28 in the *Cyclopedia of Civil Engineering, Water Supply, Irrigation and Sanitary Engineering*, published by the American School of Correspondence, University of Wisconsin, Madison, Wis.

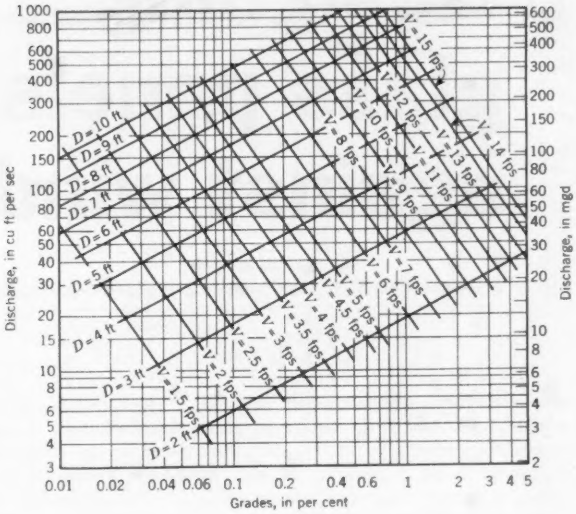


FIG. 2. Once Q (runoff in cu ft per sec) is found, the culvert diameter can be determined from these curves if the assumptions given in the text apply.

Girder-to-column flange connection

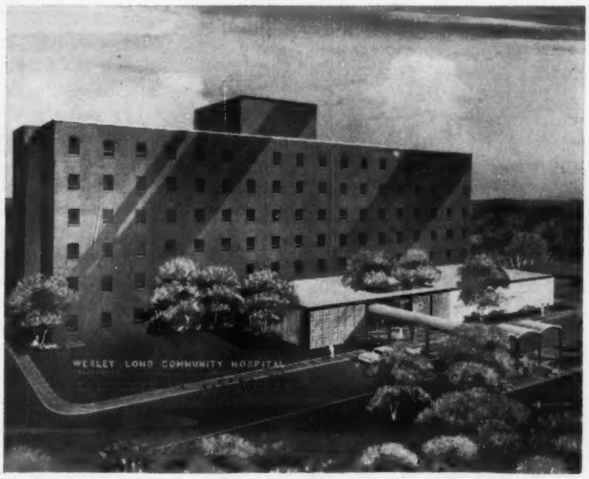
E. E. HANKS, F. ASCE, Regional Engineer, American Institute of Steel Construction, Inc., Greensboro, N. C.

An interesting connection was used for steel members in the six-story steel-framed Wesley Long Community Hospital now under construction in Greensboro, N. C. The offset girders along the corridors are connected to the flanges of the wide-flange columns, permitting pipes to be placed against the webs of the columns and to extend straight up through the floors without bends. While this detail added only a little to the usable floor area, it avoided the use of additional pipe chases, which otherwise would have been required.

The eccentricity of the connection increased the column weight by one size over that required for a concentric load. Otherwise the connections did not add anything to the steel cost.

The steel erector has stated that this form of erection presented no problems and added nothing to the erection costs. High-strength bolts were used for the field connections. The building will cost about $2,450,000, not including equipment. The completion date is set for April 1961.

Engineers and architects for the structure are J. N. Pease & Company, Charlotte, N.C. The general contractor is King-Hunter, Inc., of Greensboro, N. C. The structural steel was fabricated by the Carolina Steel Corp. and erected by the Craven Steel Erecting Co., both of Greensboro.



Offset girders along corridors of new hospital in Greensboro, N. C., have their webs connected by high-strength bolts to the flanges of the columns. Architect's rendering is at right.

Designing glass panels against wind

W. RICK WALLIS, F. ASCE, Consulting Engineer, Fresno, Calif.

A structural consideration that is often overlooked is the design of glass panels exposed to wind. All the other components of a building, tower, or other structure may have been carefully analyzed for a 15, 20 or 30-psf wind load, depending on their height from the ground and the prevailing design code, but the thicknesses of glass panels are often arbitrarily specified.

Unlike many companies that furnish steel, for example, the companies that furnish plate glass often appear unconcerned about the structural adequacy of their product for its intended use. Breakage losses during storms are usually covered by insurance policies of comprehensive type. Looting after failure of the glass is also often covered by insurance; often, and correctly, it is not so covered because of the expectation of police protection, or because of the nature of the property and of the goods inside the structure.

Good insurance coverage does not mean that the owner is following the best procedure. Adequate design of the glass panels, even if not recognized by the insurance company in fixing the rate for the structure, will certainly be reflected in time by reduced operating costs for the insurance company and so will result in lower coverage rates to the owner.

The loss in dollars and cents is difficult to assess when the failure of a glass panel causes human injury or death, or even a strategic operational interference. For example, consider the case where glass panels protect a control-tower operator and his delicate equipment, which must function to effect the safe landing of many planes during a storm. There is no excuse for tolerating the possibility of failure of the glass panels in such a situation.

Glass manufacturers generally have established conservative design formulas and practices to determine the glass thickness for any specific case. Recommended factors of safety are between 5 and 10, if use involves a substantial hazard. They properly leave the choice of the safety factor to the design engineer.

Comparative design results for a typical case follow. For a polished plate-glass panel 5½ ft × 7½ ft, designed for a wind load of 20 psf, the following formula can be used:

$$PA = 3.48\frac{R}{s}t^2F \quad . \; . \; . \; . \; . \; . \; . \; . \quad (1)$$

in which

- P = pressure, in psf
- R = modulus of rupture (6,000 psi in this case)
- t = thickness, in in.
- A = area, in sq ft
- F = factor for ratio of length to width of pane
- s = safety factor (1 to 10)

Rearranging Eq. 1 and solving for t,

$$t = \left(\frac{PAs}{3.48\,RF}\right)^{1/2}$$

$$= \left[\frac{20\,(5.5 \times 7.5)\,s}{3.48 \times 6{,}000 \times \frac{7.5}{5.5}}\right]^{1/2}$$

$$= (0.0290\,s)^{1/2}$$

When $s = 10$, $t = 0.54$ in.
$s = 5$, $t = 0.38$ in.
$s = 2\frac{1}{2}$, $t = 0.27$ in.

Using ASCE-ACI Joint Committee formula

Using the ASCE-ACI Joint Committee formula (Recommended Practice and Standard Specifications for Concrete and Reinforced Concrete, American Concrete Institute, June 1940, Sections 809-812 inclusive; Part II, June 1940, ASCE *Proceedings*, Vol. 66, No. 6) for rectangular panels supported on four sides and built monolithically with supports,

$$m = \frac{\text{short span}}{\text{long span}} = \frac{5.5}{7.5} = 0.73$$

Using the following nomenclature,

- M_m = positive moment at midspan
- $\frac{2I}{T}$ = section modulus
- f_s = allowable flexural stress, in psi
- S = short span, in ft

and considering the four edges discontinuous,

$$M_m = \text{coefficient} \times P \times S^2$$
$$M_m = 0.070 \times 20 \times (5.5)^2 \times 12 = 507 \text{ in.-lb}$$

$$\frac{2I}{T} = \frac{12\,t^2}{6}$$

$$f_s = \frac{R}{s} = \frac{6{,}000}{s}$$

$$\frac{M}{f_s} = \frac{507s}{6{,}000} = \frac{12\,t^2}{6}$$

$$t = \left(\frac{507 \times 6 \times s}{6{,}000 \times 12}\right)^{1/2} = (0.0423\,s)^{1/2}$$

When $s = 10$, $t = 0.65$
$s = 5$, $t = 0.46$
$s = 2\frac{1}{2}$, $t = 0.33$

The ratio of increase in thickness of glass by the ASCE-ACI Joint Committee formula, for this case, is

$$\left(\frac{0.0423\,s}{0.0290\,s}\right)^{1/2} = 1.20$$

The writer has found that the glass panels of airport control-tower cabs are particularly vulnerable to wind action. Many panels have been cracked or broken. Occupants of cabs have intuitively become aware that panels are often dangerous under severe wind conditions and sometimes have vacated the cab.

The walls are of glass from sill to ceiling all around, necessitating double or thermopane panels to protect against the summer sun, and the glass must be tinted to prevent glare. The cost of the glass thus becomes an important consideration. A factor of safety of 2½, using the ASCE-ACI Joint Committee formula, has been employed successfully by the writer for glass thicknesses on a number of airport control towers, beginning in 1948.

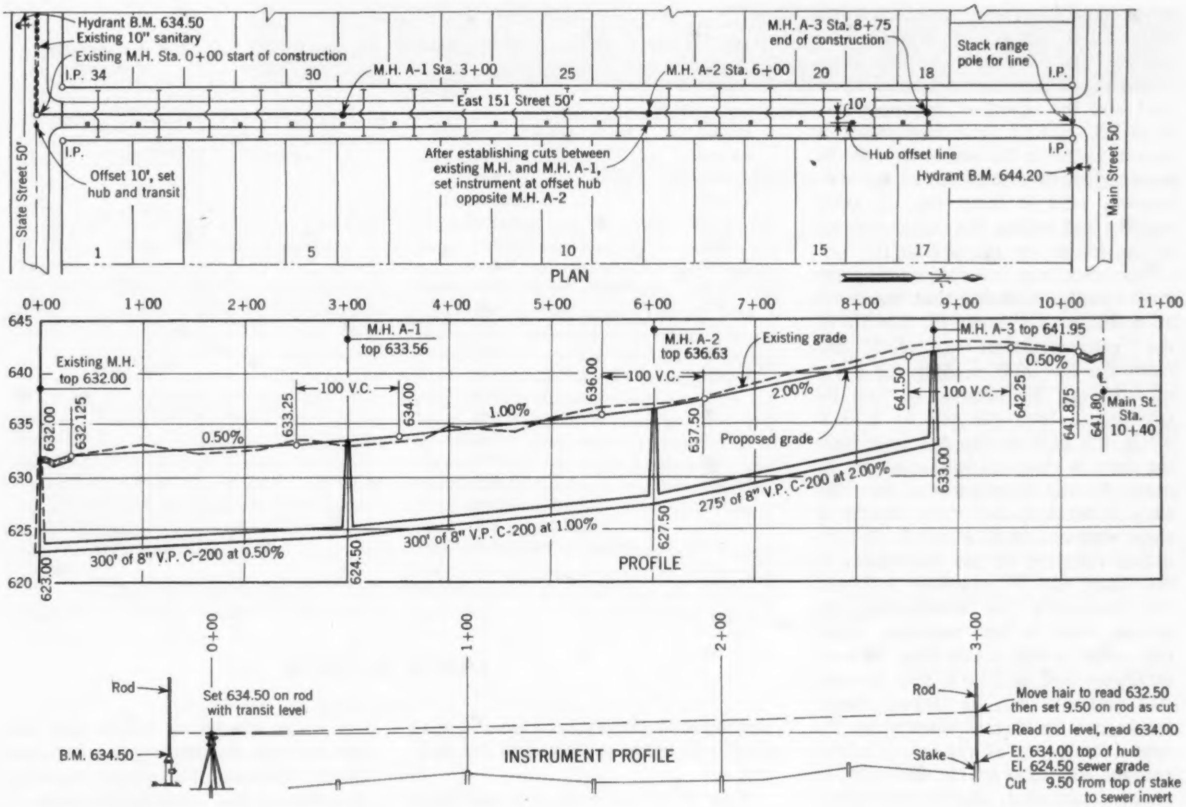


FIG. 1. Field procedure for sewer stakeouts.

Direct reading of cuts and fills

ARTHUR H. WUNDERLICH
Tkach & Wunderlich, Consulting Engineers
Cleveland, Ohio

For some time a direct-reading type of rod has been used by the survey crews of Tkach & Wunderlich in determining cuts and fills when staking underground utilities, pavements, and sidewalks. Since the direct-reading rod can be adjusted to the actual elevation of the bench mark, a transit can then be utilized to obtain direct readings of cuts and fills in most applications. We have noted a reduction of about half in crew time since employing the procedures described here. It has also been determined that a two-man crew is adequate for construction survey work. A typical utilities drawing, Fig. 1, shows the procedure.

The setting of hubs can be accomplished in a conventional manner or a more simplified method may be used. When the direct-reading principle is applied, the simplified method requires only that the manholes be located with a fair degree of accuracy. With a two-man crew, the transit is set on the offset hub of the existing manhole and line is established by the standard method. The two men tape between the terminal manholes, setting chaining pins at each even 100-ft station and at intermediate manhole locations—aligning themselves as they continue along the route of the proposed construction. To make sure that no taping errors have been made, a distance check from the last manhole located should be run, as in the example, 140 ft to the line of the offset iron pins. The instrumentman then aligns the other member of the party in driving hubs, starting at the existing manhole. Hub settings are made at paced intervals of 25 or 50 ft as required and checked into each 100-ft station, where chaining pins have been previously set.

When the alignment is completed, the transit is leveled, the direct-reading rod set on the bench mark, and adjusted to read the bench elevation, which in the example is 634.50 ft. The rod is then set on the offset hub for manhole A-1 and an elevation of 634.00 is noted. The slopes of the

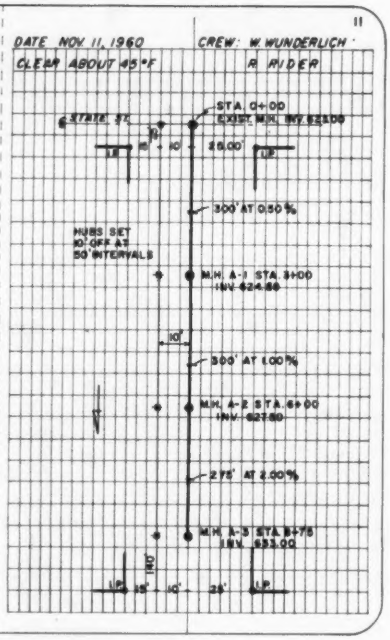
sewer and inverts at manholes are taken from the design drawing and recorded in the notebook. The slope of the initial run of 300 ft is 0.50 percent and the invert of manhole A-1 is at El. 624.50. The instrument is now adjusted to the same slope as the sewer. This is accomplished by subtracting 1.50 ft from the 634.00-ft reading and setting the center reticule of the transit on El. 632.50 ft.

The next step involves reading the cuts directly. Knowing that the invert at manhole A-1 is at El. 624.50 ft, the instrumentman subtracts this from the 634.00-ft reading for a cut of 9.50 ft. The rodman is then instructed to reset the rod to 9.50 ft while it is held on the A-1 hub. Now the crew is ready to read the cuts directly for the hubs between the transit and manhole A-1. The change in slope that occurs at manhole A-1 requires resetting of the instrument at the offset hub for manhole A-2, and the procedure for establishing the proper slope is then repeated. From this position the sewer runs between manholes A-2 and A-1, and between A-3 and A-2 can be staked. Bench marks can be carried throughout the runs since the cut at any hub is known and the elevation of the hub can be readily computed. As in any survey dealing with elevations, a bench check should be made at the end of the staking.

Fills have not been discussed here, but under conditions where they are encountered, the reading is subtracted from 10.00 and the proper notation is made on the construction stake.

10

STA.	EL. SET	EL. OBS.	INVERT	CUT/FILL	REMARKS
B.M.#1	634.50				SEE B.M. BOOK PG. 20
STA. 0+00 EXIST. M.H.		623.01	623.00		OK
HUB 0+00				C-9.00	
" 0+50				C-9.24	
" 1+00				C-9.65	
" 1+50				C-8.63	
" 2+00				C-8.60	
" 2+50				C-8.92	
" 3+00		634.00	624.50	C-9.50	-1.50 ↑ +3.00 ↓
" 3+50				C-8.22	
" 4+00				C-9.40	
" 4+50				C-8.41	
" 5+00				C-9.23	
" 5+50				C-9.74	
" 6+00				C-9.40	
" 6+50				C-9.12	
" 7+00				C-9.49	
" 7+50				C-9.62	
" 8+00				C-9.60	
" 8+50				C-9.85	
" 8+75		643.20	633.00	C-10.20	-5.50↑
" 8+75	643.20				
B.M.#2		644.23			644.20 OK



SAMPLE OF NOTES

Radius for a curved row of columns

H. S. SCHICK, M. ASCE, Structural Engineer, Edwin A. Keeble, Architect, Nashville, Tenn.

In my work in the office of Edwin A. Keeble, an architect of Nashville, Tenn., it was recently necessary to compute accurately the length of radius and the location of the center of curve for a curved row of columns. The center of the row was determined within narrow limits by three fixed points. It is easy enough to plot a curved line through three fixed points but when greater accuracy is required than can practicably be secured by scaling, it is necessary to determine the mathematical relation among the points.

With the thought that some engineers may find the solution of interest, I present its essential elements here. In the sketch, Fig. 1, the critical points that determine the location of the row of columns are A, B and C. Pass a straight line through A and B and produce the line beyond A to the point N, directly opposite the point C.

Then from point M, halfway between A and B on the line AB, erect a perpendicular to the line and produce its length indefinitely to point O. Next drop a perpendicular from point C to the extension of the line AB at point N and another perpendicular to the line MO at point P. The result is a right-angled rectangular figure, $CNMP$, in which the long sides each equal $a + b$ and the short sides each equal c.

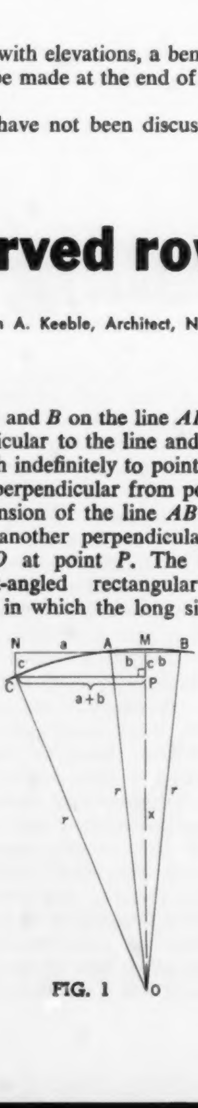


FIG. 1

The value of x, the distance from P to O, can readily be determined. Hence the length of the radius r can be found and the position of the center O of the curve can be located.

The three equations used in this method are:

$$r = \sqrt{(a + b)^2 + x^2} = \sqrt{(x + c)^2 + b^2}$$

$$x = \frac{a^2 + 2ab - c^2}{2c}$$

The measured distances are a, b and c.

$a = AN =$ vertical projection of CA on MN

$b = BM = AM = \frac{AB}{2}$

$c = CN =$ horizontal projection of CA on CN and on MO

$r = AO = BO = CO$

$x = PO$

THE READERS WRITE

High fire resistance found for prestressed concrete

To the Editor: The authors would like to clarify the points raised by Henry J. Stetina in his letter to the editor in the March issue, p. 63, with regard to their article, "Prestressed Concrete Resists Fire Damage" (December, 1960 issue, p. 36).

Mr. Stetina referred to our Conclusion No. 11, which in essence states that the structure investigated would have received a fire retardant rating more than adequate to meet the requirements of local, state or federal building codes. He stated that our conclusion is not justified "in the absence of standard ratings for this material." He continued, "It becomes equally valid to arrive at other conclusions."

We would like to point out that fire tests on prestressed concrete, in full conformity with ASTM-E119, which Mr. Stetina suggested should be made, have been in progress for several years. Based on the results of these tests, Underwriters' Laboratories, Inc., recently gave a two-hour label service to the double-tee panel shown in the attached drawing. The dimensions of the monowing tees used in the Bargain City structure are basically the same as those given in this drawing. In fact, the 2-in. clearance of the monowing tees is in excess of the 1⅝-in. minimum clearance of the section that received the two-hour label. (Side clearances are also larger.)

In the light of information received from the owners, we cannot agree with Mr. Stetina's statement that the fire load was "rather low," or his implication that the intensity of the fire was relatively low. To the contrary, steel appurtenances such as steel doors, control boxes and so forth were found in buckled, twisted and distorted condition, which indicated that the fire was of a very high intensity.

In view of our findings we seriously question whether "a structure of conventional materials, fire protected for a prescribed rating as indicated" would have withstood "without structural damage the conflagration described in this article." The real issue at hand is how much fire protection a steel member would require in order to exhibit the same behavior under severe fire conditions as did the prestressed concrete members in the Bargain City structure, with their built-in fire protection.

Charles C. Zollman
Partner, Schupack and Zollman

Newton Square, Pa.

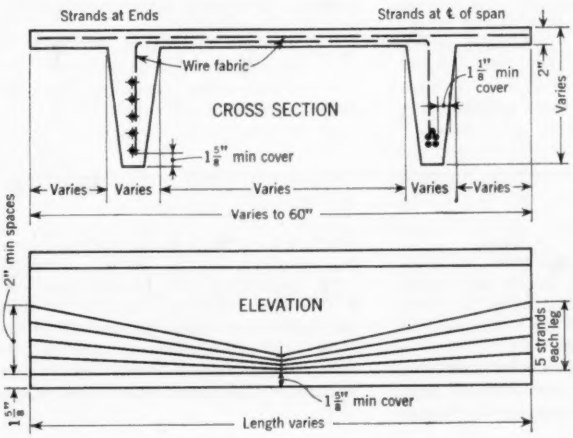


FIG. 1. This prestressed concrete double-tee panel was given a "two-hour fire retardant" classification in January 1961 by Underwriters' Laboratories Inc.

Editor's Note: A letter was received from Norman Scott, A.M. ASCE, Executive Secretary of the Prestressed Concrete Institute, Chicago 6, Ill., which calls attention to several U. S. fire tests made on prestressed concrete assemblies in accordance with ASTM-E 119. Another letter, from S. Galezewski, M. ASCE, a consulting structural engineer and a member of the Advisory Board of the Fire Prevention Research Institute, Gardena, Calif., alludes to successful fire tests of prestressed concrete members run in conformity with ASTM-E 119 standards at the Institute and at Underwriters' Laboratories, Inc., Northbrook, Ill.

Shelters not sufficient for civilian protection

To the Editor: Last October the Office of Civil Defense, on recommendation of the Coordinating Committee of ASCE, sent copies of the "National Plan for Civil Defense" and "Fallout Shelter Surveys, a Guide for Architects and Engineers" to members of the ASCE. The shelters seem inadequate. "Hard" shelters for missile bases may be figured for a 1,000-psi blast; the fallout shelters are not designed for pressure at all. Against radiation, "reduction factors" are elaborately computed, but no minimum is recommended. Space, ventilation, plumbing, and food are specified. But there is no indication as to what degree of protection is contemplated.

The "Study of Non-Military Defense" by the Rand Corporation, 1958, gives some background for appraising the OCD "Guide." The "Study" estimates that in the present state of preparedness of this country, an all-out nuclear attack would kill 160 million Americans. If fallout shelters affording a reduction factor of 1/30 are provided for the population outside target areas (that is, cities) and if there is time for everybody to reach them, only 70 million would be killed. The cost of such protection would run to about $20 billion.

Rand however prefers "heavy" shelters, about 800 ft underground, to cut deaths to 27 million, at a cost of $149 billion. Such a project, with ventilation, decontaminated water, food, and sanitation for 153 million survivors and 20 complete industrial complexes to start rebuilding our economy, would indeed present an opportunity and a challenge to our engineering fraternity. It would also alleviate unemployment for several years.

Rand cautions that the appropriation of $149 billion must not interfere with our military budgets. OCD evidently accepts this warning, and will settle for even less than Rand's $20 billion program with 70 million dead. As I interpret OCD's program (from the material sent to ASCE members) it would save all but 144 million of us.

Engineers should face the fact that there is no feasible defense. Another solution must be found: disarmament, world government—let live . . . and live.

Henry Wilcox, M. ASCE

South Norwalk, Conn.

"Benefits" cannot be paid for by the "employer"

To the Editor: Your February issue carries an article (p. 49) on "Environment in Exemplary Engineering Offices," by Irving F. Ashworth, F. ASCE, in which interesting and informative data are presented on employment conditions. However, a common fallacy in economics appears in this article: the idea that employee "benefits" can be paid for, in whole or in part, by the employer.

In discussing retirement plans and group health insurance plans, the author refers to "employee's contributions" and "employer's contributions." It should be understood that these designations are merely bookkeeping distinctions, and are irrelevant to the question of whether employment conditions are good or bad.

Consider the case where the "employee's contribution" is assumed by the employer. Is this not financially the same to both parties as a raise in pay of the same amount? Conversely, if the employer discontinues his "contribution," this is equivalent to a cut in the employee's pay. What matters to the employer is the total cost of keeping a man on the payroll. This sum must be classified as "pay," since there can be no such thing as a gift in the business world.

Certainly it matters little to the employer whether he: (1) gives part of this "pay" to the employee and sends the balance to various accounts in his name, or (2) delivers the entire sum to the employee. However, it may make some difference to the employee, because, in effect, the employer is spending the employee's money for him, and possibly not in the manner that the latter might elect if he had a free choice.

Each of us can test this concept in his own experience. When you hire a babysitter or a gardener, it is immaterial to you whether you pay $2x$ dollars directly to the individual, or x dollars directly and x dollars in some indirect manner. In either case, you consider $2x$ dollars as the employment cost, or "pay." This principle is not altered in any way by shifting the scene to a large firm with thousands of employees. The idea that employees can somehow dig more out of their firms if they ask for "benefits" rather than a direct pay raise is somewhat naive, since "benefits" are quickly translated into dollar employment costs by accounting departments.

Carrying this reasoning a step further, we can see that there is no such thing as a "paid vacation." A man is valuable to his employer only when he is working, and it is only for this work that he can be paid. (Again, you can test this by considering your sitter or gardener.) It follows that when a salaried man is not working, he is living on his savings, which can be considered as being "on deposit" with his employer. Obviously, a two-week vacation "with pay" means that a man's earnings over 50 weeks are paid to him in 12 equal installments. (This concept is clear to all teachers!) Thus a man's vacation does not directly cost the employer any money—only inconvenience in not having the man's services available during the vacation period, and in having to reschedule the work to some extent. A vacation is something of value, certainly—but it carries no financial reward.

The use of the term "employer" in the above context, although quite usual, is unfortunate, since what is really meant is "the management." The "employer" is the customer, of whom the managers and all others are the employees. With these more precise labels in mind, it becomes clear that a "raise" is not something paid by the management—it must be paid by the customer (the true employer). Digressing for a moment, a wage strike is usually a situation where one group of employees wants another group of employees to quote higher prices to the customers, while this second group thinks that such a step is not in the best interest of the firm as a whole.

These interpretations are not merely pedantry, but essential to an understanding of how the market economy works. Failure to grasp such fundamentals leads to much unnecessary strife in our modern industrial economy.

Jackson L. Durkee, F. ASCE
Asst. Engr., Fabricated Steel Construction, Bethlehem Steel Co.
Bethlehem, Pa.

Unsymmetrical X-bracing detailed by simple method

To the Editor: In structural steel detailing, X-bracing may be unsymmetrical for one reason or another. The following method is suggested for the detailing of such bracing. Other formulas are available but the one I have derived does not to my knowledge appear in textbooks. It is,

$$D = \frac{\tan a + \tan b}{C}$$

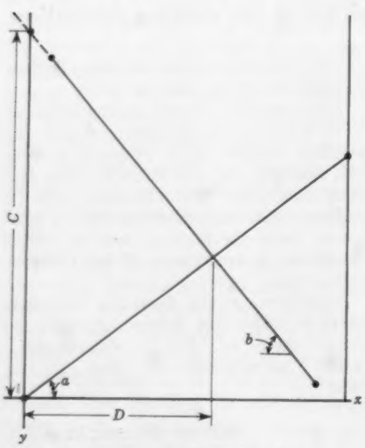


FIG. 1. Unsymmetrical X-bracing.

The notation is defined in Fig. 1.

To make the problem clearer, all given dimensions and work points have been omitted. Also, it is assumed that the y-axis always passes through the work point of the diagonal, as shown.

Angles a and b are first calculated from given data. Once the value of D has been determined, all the other necessary dimensions are readily found.

S. L. Krechefsky
Kansas City, Mo.

Greenheart timber has long service record

To the Editor: Service records of Greenheart timber in the United Kingdom over the past century are of sufficient significance to merit dissemination through Civil Engineering to the entire engineering profession for reference. These data were requested from Britain as Greenheart grows only in British Guiana and substantial marine use of this wood in U. S. harbors started only within recent decades.

Alexander McDonald, M.I.C.E., secretary of the Institution of Civil Engineers (London), recently informed the writer that Greenheart used in dock gates at Liverpool since before 1850 has suffered no deleterious effects under the 24-ft range of tide there. R. P. Woods, Principal Scientific Officer, Timber Development Association Ltd., London, provided further data based on a survey by dock and harbor authorities carried out in the early 1950's. Following are service performance records of Greenheart used in waterfront facilities in the United Kingdom:

Place	Life
Ayr	50 years, good
Dover	30 years plus
Dundee	Over 50 years
Grangemouth	40 to 50 years
Granton	80-year life
Greenock	Up to 75-yr life, excellent
Harwich	25 years plus
Poole	70 years approx.
River Tees ports	30 to 40 years
Southampton	50 yrs and up
Sunderland	At least 50 yrs
Troon	50 years, good

A fully documented report on "Greenheart (Nectandra Rodioei), Its Outstanding Merits, Properties, and Economics in Waterfront Facilities," by the writer, may be found in the *Proceedings* of AREA, vol. 61, 1960, pp. 311-330.

Shu-t'ien Li, F. ASCE
Consulting Engineer
Mobile, Ala.

ASCE NEWS

Problems of Metropolitan Environment Studied

The Society's Sanitary Engineering and City Planning Divisions joined the attack on environmental problems at the important Conference on Environmental Engineering and Metropolitan Problems held at the Technological Institute of Northwestern University, Evanston, Ill., March 21 and 22. Joining the Institute in sponsoring the venture were the U. S. Public Health Service and the Northeastern Illinois Metropolitan Area Planning Commission. Other participating groups cut a wide swath through the many organizations concerned with metropolitan environment—among them the American Management Association, the American Public Works Association, and the American Water Works Association. Conference chairman was Prof. John A. Logan, of the host institute.

General agreement on three points formed a basis for discussion at the conference:

- Modern urban life is so complex and hectic that it tries the knowledge and skills of all the professions which claim proficiency in such matters.
- The rapid growth of urban populations (frequently termed explosive) creates problems faster than they can be solved.
- Every crystal ball gazer agrees that the trend is toward more urbanization rather than the reverse.

Starting with these points of agreement, the 300 in attendance found many areas in which progress can be made. In opening the conference, Harold B. Gotaas, dean of the Institute, commended the group for its attempt to improve environmental engineering. He noted that problems of water supply, flood control, air and water pollution, and transportation, plus many other factors, are involved. He stressed the need to know more; to have more public understanding and support for efforts to improve the environment in which man "insists on living"; and, then, to have the money to do the job.

Readers of Civil Engineering are aware of the need to improve metropolitan environments, and realize the extensive studies essential to finding a solution to problems. Such matters were discussed at length by the experts, and the text of their remarks will be available later in the conference proceedings. It was generally agreed that to win public support and financing, health officials, sanitary engineers, municipal officials, city planners, social and political scientists, and others involved in the complicated business of improving environment must have more opportunity to meet together, work together, and share common problems and solutions. This means more cooperation and less competition. It means more meetings between various groups (the very mention of more meetings brought a pained look to most faces). It means more agreement on which types of specialists are best suited to solve which types of problems.

Speaking of this during his discussion of the government's role in improvement of metropolitan environment, Wesley E. Gilbertson, sanitary engineering director of the U. S. Public Health Service, called for "cooperative relationships expected with other groups, such as the HHFA and BRAB, and the technical and professional societies. Such mutual understandings," he noted, "have been very productive in the past. We see real benefit coming from expanded joint activities in the future."

Specific needs were brought into focus in the session on Air Pollution Problems. Led by John A. Maga, chief of the California Bureau of Air Sanitation, this one session involved the professional interests of several kinds of engineers, chemists, meteorologists, biologists, M.D.'s of several sorts, political scientists, city planners, economists, and the personal interests of everyone who must breathe.

Coincident with improved cooperation among the professions is the plan for improved public understanding and support. Speaking on this

Conference get-together shows (in usual order, left-hand photo) Nathan Cherniak, chairman, City Planning Division; ASCE Director Samuel Baxter, Board Contact Member for the Sanitary Engineering Division; Lewis Young, member of Sanitary Engineering Division executive committee; and James Follin, member of City Planning Division executive committee. Right-hand view shows General Conference Chairman John Logan with Harold B. Gotaas, dean of the host institution.

point, Roy Sarenson, chairman of the California Governor's Commission on Metropolitan Problems, stated: "The essential theme of this view is that citizens must want and demand public policy and governmental forms in metropolitan areas which will enable engineers, planners, public health and public works officials, and others to use their professional technology to create a humane urban environment for man. Civic, business, political, and mass communication leadership at the metropolitan level all have important roles in translating the complexities of environment into understandable terms and choices."

He called for "the awakening of the public to a recognition of the metropolitan reality as an economic, social, and physical fact and awareness of the consequences of neglect in regional planning and action." This "awakening" is not exactly a new undertaking, but the group thought it could do something about it. To carry the torch outside the meeting rooms in Evanston, tentative proposals were made for area-wide programs and projects. Leadership is expected of the governmental units and profestional societies represented at the conference in planning and conducting such public health activities at regional and local levels.

Copies of the conference Proceedings may be ordered by mail from the Department of Civil Engineering, Northwestern Technological Institute, Evanston, Ill.

ASCE Names Four Honorary Members

Four distinguished members of the Society were elected to honorary membership in ASCE during the Phoenix Convention. Those receiving this highest honor the Society can bestow are:

Samuel B. Morris, consulting engineer to the Los Angeles Department of Water and Power and a former Director and Vice President of the Society. Widely known in West Coast water-supply circles, Mr. Morris for 22 years served the Pasadena Water Department as chief engineer and general manager. Morris Dam, built during this period, was named in his honor. Mr. Morris is also famous as a teacher, having served as professor of civil engineering at Stanford University and as dean of the Engineering School there for nine years.

George S. Richardson, senior partner in the Pittsburgh firm of Richardson, Gordon and Associates, and one of Pennsylvania's best-known consulting engineers. In private practice since 1937, Mr. Richardson has been instrumental in the design of many important bridge and expressway projects, including the Delaware River Turnpike Bridge and stretches of both the Ohio and Indiana turnpikes. He has also done extensive work on mill foundations and structures for U. S. Steel and Jones & Laughlin. He has served the Society as Director and the Pittsburgh Section as president.

Thorndike Saville, consultant to the president of the University of Florida, Gainesville, Fla., and dean emeritus of the New York University College of Engineering. An international authority in the fields of water supply, hydrology, and coastal engineering, Dr. Saville has served many industrial, federal, and state agencies in an advisory capacity. He has been Director of ASCE; president of the American Society for Engineering Education; and president of several International Conferences on Coastal Engineering.

Abel Wolman, professor of sanitary engineering at Johns Hopkins University and a leader in the sanitary engineering field. His innumerable services have included fifteen years as chief engineer of the Maryland State Department of Health and twenty years as head of the Sanitary Engineering and Public Health Departments at Johns Hopkins. One of the first to recognize the hazards in disposal of radioactive wastes, he alerted health and pollution control agencies to the challenge of environmental sanitation. He has been president of the American Water Works Association and the American Public Health Association.

Presentation of these honorary memberships will be a feature of the Annual Convention in October. Biographies and photos of the new Honorary Members will be published in the October issue.

British Engineers at United Engineering Center

ASCE Executive Secretary William H. Wisely accompanies officers of the British Institution of Civil Engineers on inspection tour of the United Engineering Center which is nearing completion. With Mr. Wisely are Sir Herbert Manzoni (left), president of the Institution, and Alexander McDonald, secretary.

New Executive Secretary Appointed for ASEIB

Thomas R. Camp, chairman of the American Sanitary Engineering Intersociety Board, announces the appointment of Thomas R. Glenn, Jr., M. ASCE, as executive secretary of the Board and transfer of its office to 117 Benner St., Highland Park, N. J. All communications with the Board or the American Academy of Sanitary Engineers should be addressed to Mr. Glenn at Post Office Box 143, Highland Park, N. J.

Mr. Glenn brings a wealth of sanitary engineering background to this voluntary activity. He received a B.S. degree in chemical engineering from the University of Texas and an M.S. degree in sanitary sciences from New York University. Since 1957 he has been associated with the Interstate Sanitation Commission, New York City, where he is now director and chief engineer. He taught sanitary engineering at Rutgers University for

more than ten years prior to joining the Interstate Sanitation Commission. During World War II he was on the teaching staff of the U. S. Naval Academy at Annapolis, after which he spent two years on sea duty. He has been consultant on many sanitary engineering projects.

The American Sanitary Engineering Intersociety Board, Inc., was organized to improve the preparation and professional standing of sanitary engineers. Through its certification program, engineers who meet the rigid requirements of the Board are designated Diplomates of the American Academy of Sanitary Engineers. More than 1,000 engineers have been certified and enrolled as Diplomates of the Academy.

ASCE Membership as of April 12, 1961

Fellows	11,152
Members	16,595
Associate Members	19,141
Affiliate Members	117
Honorary Members	47
Total	47,052
(April 8, 1960	45,017)

ASCE ENGINEERING SALARY INDEX

(Prepared Semiannually)

Consulting Firms

City	Current	Previous
Atlanta	1.38	1.21
Baltimore	1.14	1.14
Boston	1.23	1.23
Chicago	1.50	1.49
Denver	1.25	1.25
Houston	1.26	1.26
Kansas City	1.19	1.15
Los Angeles	1.35	1.32
Miami	1.38	1.38
New Orleans	1.22	1.22
New York	1.29	1.29
Pittsburgh	1.07	1.07
Portland (Ore.)	1.28	1.24
San Francisco	1.35	1.34
Seattle	1.13	1.06

Highway Departments

Region	Current	Previous
I, New England	1.03	1.03
II, Mid Atlantic	1.15	1.15
III, Mid West	1.26	1.29
IV, South	1.12	1.12
V, West	1.13	1.16
VI, Far West	1.16	1.17

Sole purpose of this Index is to show salary trends. It is not a recommended salary scale. Nor is it intended as a precise measure of salary changes. The Index is computed by dividing the current total of base entrance salaries for ASCE Grades I, II and III by an arbitrary base. The base used is $15,930, the total of salaries paid in 1956 for Federal Grades GS5, GS7 and GS9. Index figures are adjusted semiannually and published monthly in CIVIL ENGINEERING. Latest survey was December 31, 1960.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the fifth of the month preceding date of publication)

Professor Charles H. Norris, of the Massachusetts Institute of Technology, delivered a challenging talk on "Goals for Civil Engineers" before a recent meeting of the **Hawaii Section.** According to Prof. Norris, professional societies have a rare opportunity today to make important contributions to the Country, "as we strive to re-evaluate and redefine our goals and objectives" in these turbulent times. This is most particularly true for civil engineers, who serve "society by engineering the common facilities required to control its environment. Society needs technical advice and leadership in order to formulate its needs and desires, and to mobilize its resources to attain these objectives. Civil engineers, therefore, not only must serve society in implementing its objectives, but also must advise and contribute leadership in defining them." Professor Norris in questioning whether "the present standards of technical performance are adequate to meet the challenge of the responsibilities which we envision?" continued, "I do not question the professional integrity or sincerity of individual engineers, but I do question whether our professional societies acting for us as professional groups are fulfilling their responsibilities to advance the science and profession of the group which each of them represents . . . we are doing nowhere near enough research and development to add to our knowledge and to improve our capabilities."

Hawaii Section officers are Russell L. Smith, Jr., president; Paul Liu, first vice-president; Robert Chuck, second vice-president; Raymond D. Wygant, secretary; and Hajime Tanaka, treasurer.

Mark Hollis, Assistant Surgeon General and chief engineer, of the U.S. Public Health Service, spoke to 150 members of the **Kansas City Section** on April 12. He predicted that the public health fight in the next decade would more and more focus on the pollution of air and water resources by the toxic by-products of our technologically and chemically oriented society, now that plagues (and contagious diseases generally) are no longer a threat to our health standards. This is a consequence of the ever-changing environment brought about by the continuing search for a better standard of living.

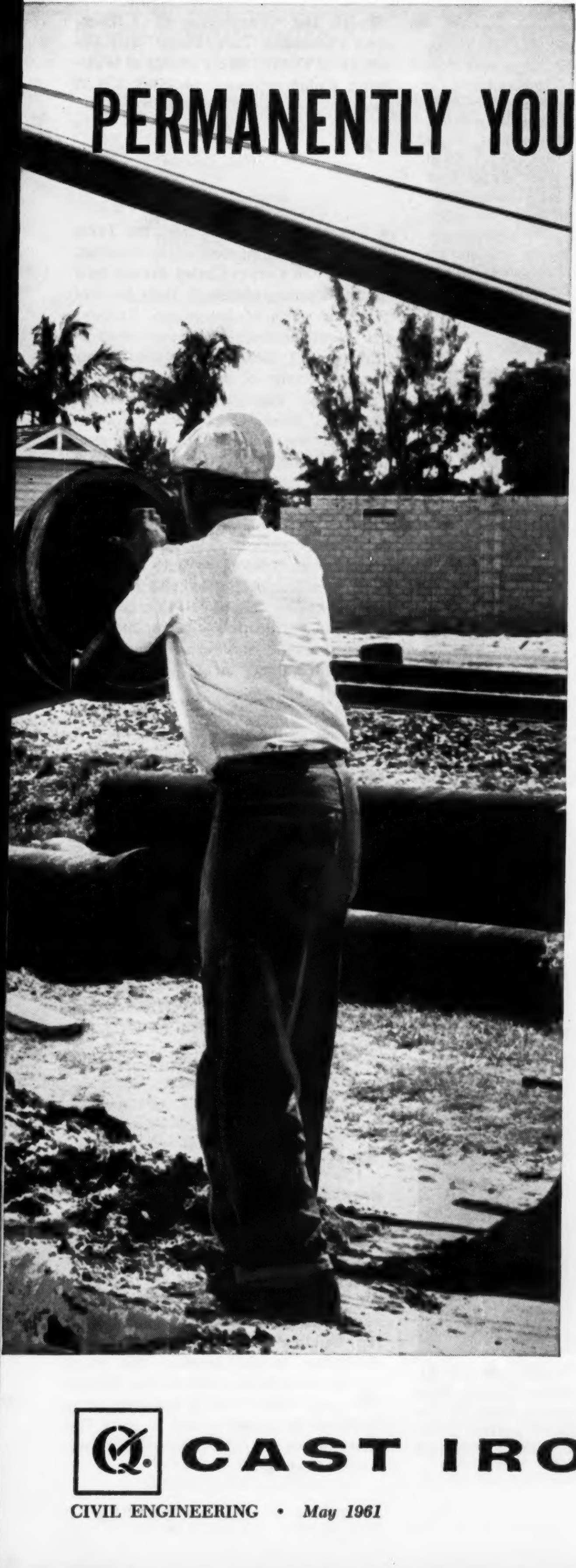
Charles R. Kolb, chief of the Geology Branch at the Waterways Experiment Station at Vicksburg, Miss., spoke to the Jackson Branch of the **Mid-South Section** on "Mississippi Loess" on March 14. This is the soil that can be seen in vertical embankments on highways around Vicksburg and along the Yazoo and Mississippi rivers. He discussed several interesting facts and engineering problems connected with loess soil, including the discovery of mastadon bones in this formation and the effect it may have on the true origin of loess.

Three Philadelphia officials, John A. Bailey, executive director of the Urban Transportation Board; Paul MacMurray, director of Project Planning for the Delaware River Port Authority; and Edson L. Tennyson, city transit engineer, discussed principal phases of a proposed comprehensive program of engineering planning and construction to attack the problem of center-city traffic congestion and rapid-transit networks from the outlying Philadelphia area before the March 14 meeting of the **Philadelphia Section.** In common with many other large American cities who have launched similar plans in recent years, Philadelphia has to deal with such factors as the interconnections and interrelationships between expressways into the central business district and the central city street system; the obligations of outlying communities to share the financial burden with metropolitan area taxpayers; and the problem of integrating these objectives with the maintenance of commuter trains, and surface and subway public transport media. The meeting, which was sponsored by the Associate Member Forum and had been heralded as "Membership Night," had on hand as guests of the Section sizable contingents of engineering students from area colleges. An excellent address by Past President Victor G. Thomassen entitled, "Why Join the ASCE," covered a wide range of professional activities of the National Society and the intra-national network of Local Sections. During the meeting the winners of the Scott B. Lilley competition recently held by the Associate Member Forum were introduced. Leo O'Connor's "On Site Sewage Treatment" won the first prize of $35.00, while James Colangelo's

(Continued on page 82)

THE MARK OF THE 100-YEAR PIPE

PERMANENTLY YOURS: CAST IRON PIPE



Installed... it stays installed

One thing sure about cast iron pipe—once it's in the ground, it's there for keeps! Over 100 American utilities, having used cast iron pipe steadily for more than a century, can testify to that. And *modern* cast iron pipe gives you greater assurance than ever: great beam strength resists heavy surface traffic; tremendous load resistance absorbs even the most forceful pressures. In fact, when you select cast iron pipe, you can anticipate no major repairs in your water supply system for the next hundred years!

Cement-lined—it stays cement-lined

A smooth coat of cement lining along the inner wall helps prevent the formation of flow-reducing particles. No matter how strong the water is, cast iron pipe always assures a free, steady flow.

Joined—it stays joined

Bottle-tight, rubber-ring joints give you leak-proof protection at the most vulnerable points of your system. Vibrations, surface traffic and washouts present no problem to cast iron pipe. Inherent ruggedness . . . built to perform under all adverse underground conditions . . . repair-free service for at least a century—all good reasons why your choice should be that of water utility experts everywhere. America's greatest water carrier: cast iron pipe.

Cast Iron Pipe Research Association, Thos. F. Wolfe, Managing Director, 3440 Prudential Plaza, Chicago 1, Illinois

CAST IRON PIPE

William N. Strobel (left), Lehigh Valley Section President, talks things over with Eric Humphries, guest speaker before a joint meeting of the Lehigh Valley Sections of ASCE and the American Welding Society. Mr. Humphries, assistant superintendent of the Bethlehem Steel Company's Steelton (Pa.) Fabricated Steel Construction Works, gave an illustrated "tour" of the facilities for the fabrication of expanded gas transmission line pipe at the Works. By automating a continuous assembly line, three mi per day of 18 in. to 42 in. dia expanded pipe may now be produced.

J. B. Schijf, technical director, Rijkswaterstaat, of the Government of the Netherlands, spoke before the Massachusetts Section's March 8 dinner meeting on "Wresting New Lands from the Sea." At the head table for the occasion were (left to right) John B. McAleer, President John H. Fullerton, Mr. Schijf, who is on a speaking tour in the United States under ASCE sponsorship, Arthur T. Ippen, Charles O. Baird, Jr., and Paul S. Crandall.

At a recent meeting of the Central Pennsylvania Section, Father Daniel Linehan, S.J. (second from left), chairman of the department of geophysics at Boston College, held the undivided attention of his audience as he described the studies made of the Antarctic during the International Geophysical Year. John Dietz (right), section president, shakes hands with Father Linehan, as vice presidents T. Robert Kealey (second from right) and Jacob Frank (left) look on.

"Design and Construction of a Four-Span Continuous Truss Bridge" and Demetres A. Vlatas' "Rapid Design of Wide-flange Columns," were awarded $25.00 each.

This month the news from the **Texas Section** comes from some of the branches. Recently the **Corpus Christi Branch** took part in honoring Homer C. Innis, head of the local office of Lockwood, Andrews and Newnam, Inc., for his selection as "Engineer of the Year" by the Nueces County Chapter of the Texas Society of Professional Engineers during National Engineers' Week. Guest speaker for the occasion was Chester H. Lauck, once the "Lum" of the radio and movie team "Lum and Abner" and now executive assistant for the Continental Oil Company in Houston. A short time ago, a noon luncheon meeting of the **Fort Worth Branch** was honored to have James R. Sims, president of the Texas Section, present a review of civil engineering in European universities. Slides of the campuses of several engineering schools were a colorful adjunct to his talk. Some 92 members and guests of the **Houston Branch** were present recently for a panel discussion of the master plan for the proposed intercontinental airport for Houston, to be called Jetero Airport. The discussion which was illustrated by several excellent exhibits clearly established the need for a second major airport in the Houston area. Moderator Joseph A. Foster, who is head of Houston's Aviation Department, and panel members Frank H. Newnam, of Lockwood, Andrews, and Newnam; N. P. Turner, of Turner and Collie; and Charles Lawler, of H. E. Bovay, Jr., dealt with such interesting aspects as runway orientation and length, air space allocation, area planning and photogrammetry.

The Marine Plaza, now under construction in downtown Milwaukee, Wis., was the topic before the March meeting of the **Wisconsin Section.** Edward L. Schulz, vice president of the Galbreath-Ruffin Corporation, leasing agent for the project, accented the use of a high quality material and system in every phase of the building design and construction. According to the speaker, the many unique features included in the Marine Plaza will make it one of the outstanding buildings in America, and a good first step towards the redevelopment of downtown Milwaukee.

ASCE CONVENTIONS

ANNUAL CONVENTION
New York, N. Y.
Hotel Statler
October 16-20, 1961

HOUSTON CONVENTION
Houston, Tex.
Hotel Shamrock
February 19-23, 1962

OMAHA CONVENTION
Omaha, Nebr.
Sheraton-Frontenelle
May 14-18, 1962

TECHNICAL DIVISION MEETINGS

AIR TRANSPORT CONFERENCE
Miami Beach, Fla.
Carillon Hotel
May 11 and 12, 1961
Sponsored by
Air Transport Division
Airport Operators Council

ENGINEERING MECHANICS DIVISION CONFERENCE
Troy, N. Y.
Troy Building
Rensselaer Polytechnic Institute
May 18 and 19, 1961
Sponsored by
Engineering Mechanics Division

SYMPOSIUM ON WATER RESOURCES AND RECLAMATION
Fort Collins, Colo.
Colorado State University
June 12-15, 1961
Sponsored by
U.S. Bureau of Reclamation
Colorado State University
ASCE

HYDRAULICS DIVISION CONFERENCE
Urbana, Ill.
University of Illinois
August 16-18, 1961
Sponsored by
Hydraulics Division

DISTRICT CONFERENCES

DISTRICT 9 COUNCIL
Cincinnati, Ohio
Hotel Netherland Hilton
May 12 and 13, 1961

DISTRICT 7 COUNCIL
Milwaukee, Wis.
August 11 and 12, 1961

A study of the needs of the Missouri State Highway Commission, including State highways as well as County and City roads, formed the crux of a talk delivered by J. J. Corbett, chief engineer of the Missouri State Highway Department, before a recent St. Louis Section monthly meeting. Later, Mr. Corbett (third from right) posed with the Section's officers. In usual order are James R. Paul, treasurer; Ralph L. Eason, vice president; Irwin A. Benjamin, secretary; R. Earl Salveter, president; John J. Leslie, vice president; and Past President Erwin E. Bloss.

LOCAL SECTION MEETINGS

Arizona—Spring meeting will be held in connection with the University of Arizona Senior Banquet in Tucson on Saturday evening, May 20.

Cleveland—Joint meeting with the Fenn College Student Chapter at Fenn College in Cleveland, on May 12.

Intermountain—Regular monthly meeting in Salt Lake City, Utah, on Friday evening, May 26. Meetings will not be held during the summer months of June, July, and August.

Metropolitan—Annual meeting in the Engineering Societies Building, New York City, on May 17, at 7:00 p.m.

Sacramento—Weekly luncheon meetings at the Elks Temple every Tuesday, at 12 noon.

South Carolina—Annual Spring Meeting at the Fort Sumter Hotel, Charleston, S.C., May 12 and 13.

St. Louis—Regular monthly luncheon meetings at the York Hotel on the fourth Monday of each month, at 12:15 p.m.

Tennessee Valley—Annual Spring Meeting at the Hotel Sevier, Johnson City, Tenn., May 19 and 20.

National President Glenn W. Holcomb (second from right) gave a brief opening talk at the annual meeting of the National Capital Section recently. Participating in the evening's activities were (in usual order) Daniel B. Ventres, Director of District 5; Ivan A. Nestingen, Under Secretary of the U.S. Department of Health, Education and Welfare, who was the speaker of the evening; Section President Eugene W. Weber; and Past National President Gail Hathaway. President Holcomb also presented Life Membership Certificates to Joseph Barnett, John David Beatty, Eric LeRoy Erickson, Philip Y. K. Howat, Merrill Donnaldson Knight, Jr., Thomas Bernard Larkin, George Wilson Malone, Edward Le Wane McGandy, Elmer K. Nelson, Paul G. Ross, Leslie Wayne Teller, Sr., and Stanton Walker.

"If steel doesn't prove to be less

Steel cut construction time and costs in the new Kettle Mills Bridge over the Duck River.

expensive you don't owe me a cent."

Angus Jessup, Consulting Engineer, Nashville, Tennessee

Steel cuts cost 10%, construction time 60 days, in short span bridge

The project called for the replacement of the 50-year-old Kettle Mills Bridge over the Duck River in Maury County, Tennessee. The new bridge had to be built to take the pounding of trucks weighing 30,000 to 40,000 pounds, and to withstand the ravages of periodic floods. It called for a 24-foot roadway and four spans, each about 70-feet long. The county wasn't thinking in terms of steel, but Angus Jessup has been designing all types of bridges for 36 years and he had other ideas. "Let me prepare two sets of plans," he said. "If steel doesn't prove to be less expensive you don't owe me a cent."

The bids confirmed Jessup's opinion that steel is the most economical material for short span bridge construction. Compared to the other method of construction, the bid for steel came in at $70,000—over 10% less—and reduced construction time from 150 days to 90 days. And steel delivered the strength and safety they needed to combat the Duck River's floods.

The new bridge uses rolled steel structural sections on the approaches and 36-inch built-up girders in the middle span, a method that is usually found in much longer spans. The type of stream, span lengths, water depth and availability of steel led to Jessup's selection of steel. He says, "We've found that for ordinary spans, steel will usually be more economical, especially where there is flood danger."

You get many exclusive advantages when you design short span bridges in steel, including economy, less construction time, lower foundation costs, greater clearance, and prompt delivery. In addition to the advantages of structural carbon steel, the use of high strength steels and constructional alloy steel can also lead to remarkable savings in both construction and maintenance costs. For full information on USS Structural Shapes and Plates and on the family of USS Steels for Bridges, write United States Steel, 525 William Penn Place, Pittsburgh 30, Pa. USS, MAN-TEN, TRI-TEN and "T-1" are registered trademarks.

USS Steels for bridge design

Structural Carbon Steel—up to 36,000 psi min. yield point
USS MAN-TEN High Strength Steel—50,000 psi min. yield point
USS TRI-TEN High Strength Steel—50,000 psi min. yield point
USS "T-1" Constructional Alloy Steel—100,000 psi min. yield strength

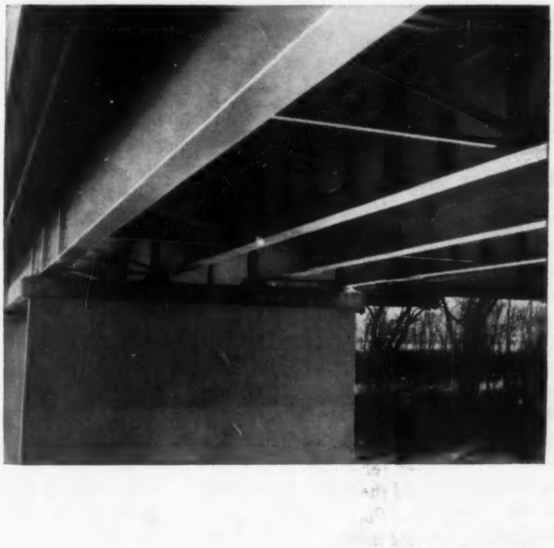
United States Steel Corporation • Columbia-Geneva Steel Division • Tennessee Coal & Iron Division United States Steel Supply Division • United States Steel Export Company.

USS United States Steel

Angus Jessup, Consulting Engineer, has been designing bridges for 36 years. During the Thirties he designed nearly all the bridges for the Tennessee Toll Bridge program. His largest project today is the half-mile-long Interstate Highway bridge to span Kentucky Lake between Nashville and Memphis.

This mark tells you a product is made of modern, dependable Steel.

Close-up of the heavy, built-up beams used in the center spans. Lighter, rolled steel structural sections were used in the approaches. Steel was fabricated and erected by Nashville Bridge Company, Nashville, Tenn. General Contractor: Hagen Construction Company.



THE YOUNGER VIEWPOINT

Committee on Younger Member Publications

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This month's editor is Associate Member Judd R. Hull, committee member representative for Zone IV.

Committeemen of "The Younger Viewpoint" solicit your comments—send your opinions, pro or con, to any of the committee members on our masthead.

Incompatibility of unionism and professionalism

"The Incompatibility of Unionism and Professionalism" was the topic of a panel discussion presented by the Department of Conditions of Practice, Committee on Younger Members, at the recently completed Phoenix Convention. This subject has been discussed rather thoroughly in CIVIL ENGINEERING. It is vitally important that Associate Members, who are the majority group joining the ranks of ASCE each year, directly from engineering colleges, discuss the subject whenever possible, to present additional information and comments on this vital issue.

The Younger Members of ASCE will play the major role in deciding whether or not engineers will become subjected to union control in the future. Do engineers need a union for collective bargaining? What "freedoms" would engineers surrender under unionism? What advantages would be gained? What is ASCE doing to prevent union-type control?

The ASCE Committee on Employment Conditions has been actively concerned with reporting the status of engineers' salaries, fringe benefits, and working conditions. Two excellent articles on this subject are "An Examination of Engineers' Compensation" by Oscar S. Bray, F. ASCE (CIVIL ENGINEERING, November 1960), and "Environment in Exemplary Engineering Offices" by Irving F. Ashworth, F. ASCE (CIVIL ENGINEERING, February 1961).

At a recent meeting of the Los Angeles Section's Associate Member Forum, Warren A. Hall, associate professor of engineering, University of California at Los Angeles, spoke to the group about "Industrial Relations, the Development of the Union and its Effects on the Professional Engineer." The question-and-answer period lasted over an hour and was finally terminated reluctantly. The meeting boasted one of the largest attendances in the Associate Forum's history. The conclusion? Young members of ASCE are seeking more information and knowledge regarding "Unionism vs. Professionalism."

Sales engineering—A rewarding field?

In a recent discussion among active Associate Members, the merits of sales engineering for the young engineer were discussed. The discussion was inspired by the article, "Sales Engineering Is Professional," by Harvey Leaver, M. ASCE (CIVIL ENGINEERING, November 1960), and although the discussion did not, in particular, challenge the professionalism of the sales engineering field, it did challenge the opportunity for the young engineer.

One participant in the discussion remarked that it was his impression that to be a sales engineer required many years of experience. Recently, this young engineer had applied for a sales engineering position with a large national corporation that was looking for an experienced registered engineer to contact design engineers in federal, state, and local public agencies, private practice, and industry and to offer technical information on design and application of the corporation's products. The sales engineering position was, however, given to an engineer with some 25 years' experience.

Another participant in the discussion was employed by a national corporation which is forming a separate sales engineering division to promote the use of the corporation's products. The company's "promotion" will consist of being responsible for: testing its products in accordance with the requirements of agencies responsible for standard specifications; preparing and distributing these technical testing data to design engineers; and making the company available as consultants for these products.

In addition to promotion activities, many sales engineers are responsible for direct selling. The sales engineer represents a large part of our active ASCE membership and many young members would like to know more about sales engineering. Is sales engineering a rewarding field for the young engineer? Sales engineers, please send your counsel to "The Younger Viewpoint."

Join the Navy—for professional recognition

From Robert C. Peace, A.M. ASCE, Lieutenant, Civil Engineer Corps, U.S. Navy, comes an encouraging letter on the Navy attitude toward young engineers:

"I am deeply concerned that readers of the 'Younger Viewpoint' may conclude, from the letter published in the December issue of CIVIL ENGINEERING, that the situation regarding young engineers in the Air Force is representative of conditions in all other branches of the uniformed services. Clarification is certainly in order with respect to the Civil Engineer Corps of the Navy. During six years' experience as a junior officer in the Navy CEC, I have observed conditions to be almost exactly opposite those described as representative of the Air Force in Associate Member Stieglitz's letter. Generally, energetic young engineers who are fortunate enough to be selected for service as officers in the Navy Civil Engineer Corps can look forward to:

"1. Leadership of high professional caliber from senior engineer officers, some of whom are recognized as leaders of the engineering profession.

"2. Continual encouragement and recognition as engineers.

"3. Assignment to important and challenging engineering tasks.

"4. Assignment of authority and responsibility in amounts considerably greater than those of their contemporaries in civilian public works and industry.

"5. Continual encouragement from seniors to actively participate in engineering societies and to obtain professional registration.

"6. Opportunities for postgraduate education at leading engineering colleges and universities.

"7. Salaries with benefits which, combined, compare very favorably with the salaries of their brightest civilian contemporaries.

"I think it is important to note that I entered the Navy not as a career officer, but as a reluctant civilian seeking to fulfill his military obligation. After two years of service under the conditions described above, I applied for augmentation and was fortunate enough to be accepted as a Regular Navy officer in the CEC.

"If the engineer graduate of today seeks either a rewarding engineering career in the service or three years of good engineering experience while satisfying his military obligation, I strongly recommend that he consider the Civil Engineer Corps of the Navy."

[*Editor's Note*: See also "Opportunities in the CEC for Graduate Engineers, "by Peter del Valle, Jr., A.M. ASCE, in CIVIL ENGINEERING for November 1958, page 56.]

BY-LINE WASHINGTON . . . . .

There were some rapid-fire developments for engineers, as Congress got back to work in mid-April. Most important were: (1) A drastic shift in construction responsibility for **missile base work,** and with it a shift in the internal responsibilities of the Corps of Engineers that will mean some job losses; (2) opening of hearings on bills that would create a **"National Science Academy"** and raise pay and change classifications of government engineering employees; and (3) strong support for an engineering approach to **stream pollution problems.**

The **shift in missile-base responsibility** was most dramatic. What happened was that the Corps of Engineers' newly established Civil Engineer Ballistic Missile Construction Office (CEBEMCO) was put under the operational control of the Air Force's newly-established Ballistic Systems Division.

The Air Force's move to reorganize its missile base work was a direct outcome of the heavy criticism that has been coming from Congress. But placing construction operations directly under an AF command is of course a logical move; it might serve to untie some of the current tangled chains of command which have been blamed for much construction and engineering delay.

The shift, however, had another repercussion: It sparked a major reduction in the number of Corps district offices having responsibility for military construction—a cut from 31 to 17—that will also result in a reduction in civilian force of about 1,700 persons (just where hasn't yet been announced). The change does not mean closing of any of the Corps' 42 U. S. district offices (except the Washington District, which now becomes an "area" under the Baltimore District), since these offices will continue to handle the nearly $1 billion Civil Works program. Note that the changes have nothing to do with Defense Department decisions to close or curtail activities at some 73 bases.

* * *

The idea of a **"science academy"** modeled after West Point or Annapolis got no support at all from engineering societies and educators. Representatives of the Engineers Joint Council, the National Society of Professional Engineers, and others opposed the idea embodied in the bill (HR 1) on the ground that such an academy would bleed existing schools of faculty and student body, and could not do as good a job as existing schools can do. Most damaging testimony, however, came from Alan T. Waterman, director of the National Science Foundation (which would be charged with operating such an academy), "that the expense and effort to create such an institution would definitely outweigh its desirability . . ."

* * *

However, a second bill sponsored by Victor L. Anfusco (D., New York) got immediate and enthusiastic support from government engineers, even before hearings were opened. Very briefly, the bill (HR 5563) would recognize engineering personnel by creating a **new Civil Service category**—PES (for Professional Engineer Scientist), instead of the now-standard "GS" ratings; raise pay scales an average of $400 a year in ranges from $6,400 (for PES 1, equivalent to the present GS 5) to $20,000 (for PES 10, equivalent to the present GS 18).

Included in the new salary classification would be "all classes of employees which advise on, administer, supervise or perform professional work in engineering research, investigation, or in the development of engineering projects, or in the development, design, construction, inspection . . . on engineering facilities, structures, systems, processes, equipment, devices or materials."

* * *

With the solid support of most industry, civil officials, and many Congressmen (as well as the Administration), it began to appear that any new **stream-pollution-control bill** will take the program away from the Public Health Service in favor of an engineering approach; will settle on about a $100 million a year grant program (vs. the $125 million in the original bill, $50 million in the present program).

* * *

The big labor news was the **AGC-AFL-CIO pact** that would put alongside the long-standing jurisdictional disputes procedure a new agreement to cover disputes between employers and labor, by insisting that all existing machinery for settlement be exhausted, then the matter be submitted to a 15-man employer-union board which would have power to make binding decisions. All strikes or stoppages would be outlawed during the settlement processes.

* * *

The long-drawn out battle over construction of either of **two huge dams** on the **Middle Snake River** will drag out a good deal further now. As is well known, the Nez Perce Dam (it will be built by a group of public utility districts) and the High Mountain Sheep Dam (it would be built by a private power company) have been contested by fishery and conservation interests because of their charge that it will be virtually impossible for spawning salmon to top the 700-ft-high structures. The Federal Power Commission has been holding long hearings on protests and other matters.

In the meantime, two new elements have entered the fight: The Interior department has announced it will start a comprehensive study of the whole Snake area, with a completion target date in 1964. More importantly, public power advocates—noting the public power policies of the new Department of the Interior—hope their case will be strengthened before the end of 1961. During 1961, three of the five FPC commissionerships will be subject to replacement by President Kennedy.

The fish-passage controversy, however, has brought to light some interesting thinking in some of the Washington agencies concerned with the problem. It runs this way: Maybe the present approach (of fish ladders, elevators, locks, etc.) is all wrong, and much too expensive. Wouldn't it be cheaper and better to create an "ideal" spawning area below any new dam, so that fish wouldn't have to cross the barrier?

FROM COAST TO COAST MORE CITIES REPORT:

1912 Denver—This 60-in. ID main was laid through a tunnel and over the South Platte River. The Water Department reports that despite a temperature range of 120 deg, "the pipe is in very good condition and is still giving satisfactory service."

1909 Springfield, Mass.—Originally installed with the expectation of serving perhaps twenty years, Springfield's 22,000-ft, 42-in. ID supply main is in its fiftieth year. Flow tests show, according to the Municipal Water Works, "that steel lines with proper coatings will give very long life as far as carrying capacity is concerned."

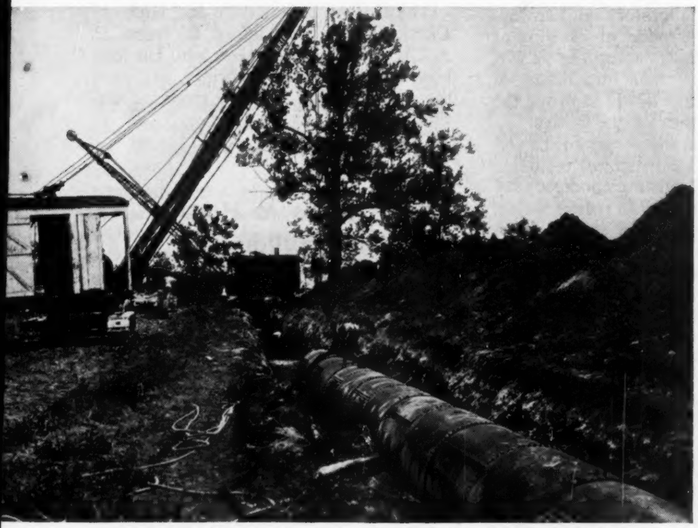
1899 Passaic Valley, N.J.—These are the giant steel penstocks at Little Falls pumping station. Since then the major portion of the water supply for the cities of Paterson, Passaic, and Clifton has passed through these venerable pipes.

1921 A washout completely undermined this thin-walled (1/4 in.) 30-in. steel main in Paterson. It held—even before being supported as shown here. Could any other pipe material stand the gaff?

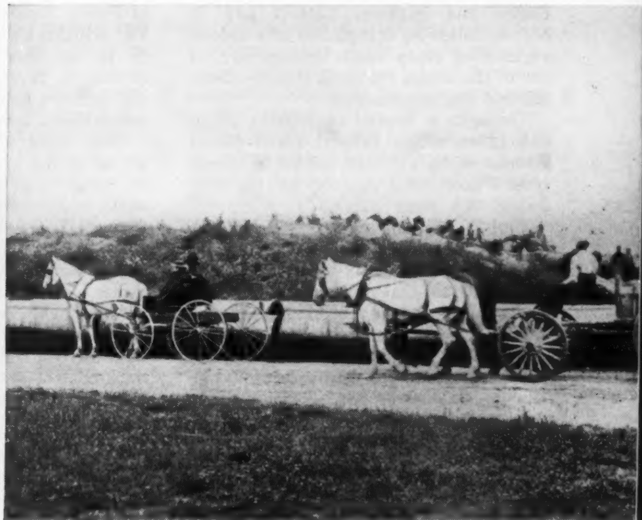
Steel

for Strength
. . . Economy
. . . Versatility

"Our old steel mains are still on the job"



1925 St. Louis—The steel main shown here being installed was by no means the city's first. They laid a 7-ft ID line nearly twenty years before. The Water Department reports "satisfactory service," and expects the steel pipe to remain on the job for many years to come.



1896 New Bedford, Mass.—The service life of the city's 8-mile, 48-in. ID steel main has spanned the years from horse-and-buggy days to the jet age—with never a failure.

The evidence is clear and overwhelming: large-diameter steel mains, properly protected and installed, give upwards of fifty years of eminently satisfactory service.

What's more, steel pipe is not subject to the costly and annoying failures that plague pipe made of brittle materials.

Remember: *every single length of steel pipe is tested at the shop in accordance with AWWA standards—usually to twice the working pressure.*

Specify tar-enameled steel pipe for your next water main.

For information about our new types of slip-joint pipe for fast, economical installation, contact the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA. *Export Sales: Bethlehem Steel Export Corporation*

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News Briefs . . .

Rapid Transit Urged For Golden Gate Bridge

The San Francisco Bay Area Rapid Transit District has formally requested approval to install rapid transit facilities on the Golden Gate Bridge. A resolution containing the "urgent" request was submitted to directors of the Golden Gate Bridge and Highway District late in March, following completion of a special engineering study which determined that use of the bridge for rapid transit is both feasible and practicable.

The span is needed to provide a key link between San Francisco and Marin County in the 120-mile rail rapid transit system now being planned for the five-county Bay Area region.

Carl H. Gronquist, F. ASCE, of the New York firm of Steinman, Boynton, Gronquist and London, which conducted the study, said that rapid transit rails can be installed beneath the present automobile roadway of the bridge without damaging either its appearance or structure. Total cost of the reconstruction would be about $9,000,000. Mr. Gronquist's report, made at a meeting of directors from both public agencies, climaxed 14 months of intensive structural and aerodynamic studies of the famed span.

Most recently completed was a special wind tunnel test at the U. S. Bureau of Public Roads laboratory at Langley, Va., utilizing a scale model of a section of the bridge. This study, according to Mr. Gronquist, revealed that installation of rail facilities actually would improve the aerodynamic qualities of the bridge.

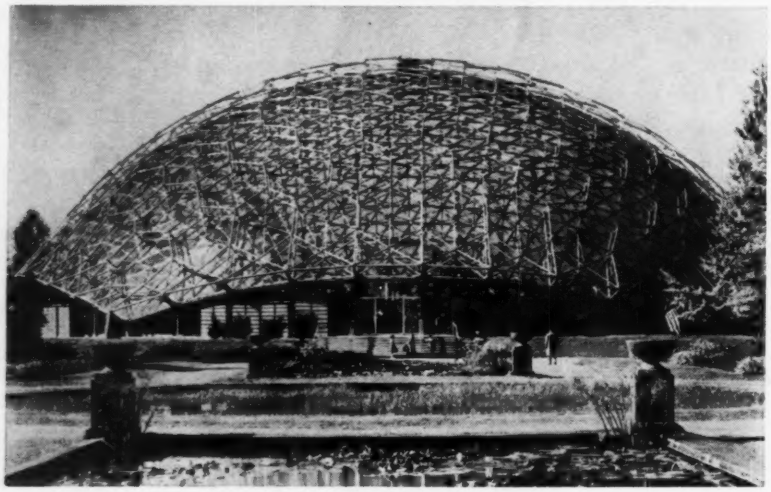
Only slight alterations would be required in the bridge structure, including the replacement of existing concrete sidewalks with steel grating, to reduce weight and wind resistance. The studies were favorable even in view of the fact that transit weight demands used were far in excess of actual requirements. For study purposes, engineers assumed four 10-car trains moving across the bridge simultaneously—a situation which the planned track-control system will make impossible—and also a spacing of trains so as to produce the worst effect on any of the span's structural members.

Plans for the entire regional rail rapid transit system are to be submitted by August 1 to county supervisors throughout the district for approval. A bond election to secure public financing for the project, estimated to cost $1,025,000,000, probably will be held in June 1962.

The Golden Gate Bridge and Highway District has asked Clifford E. Paine, F. ASCE, consulting engineer, who has long been connected with the bridge, to review the proposal and make a recommendation.

Award-Winning Structure Features Use of Aluminum

The 1961 R. S. Reynolds Memorial Award has been conferred upon the St. Louis architectural firm of Murphy and Mackey for its design of the Climatron, a display greenhouse in the Missouri Botanical Garden, St. Louis. Presentation of the award was made in Philadelphia, on April 26, during the annual convention of the American Institute of Architects, which administers the award. The award jury termed the 175-ft-dia Climatron, an aluminum and plexiglass structure built on the geodesic dome principle, "sensitively executed and strikingly appropriate to its purpose." Collaborators on the project were James Fitzgibbon, of Synergetics, Inc., Raleigh, N. C., dome consultant, and Paul Londe, St. Louis mechanical engineer. North American Aviation, Inc., Columbus, Ohio, fabricated and erected the structure, and the C. Rallo Contracting Company, Inc., St. Louis, built the foundation.



Buenos Aires to Have Sixty-Story Building

Plans are under way for erection of a $20 million, 60-story office and apartment building in Buenos Aires. To be located in the business district of the capital city, the skyscraper will be one of the world's highest commercial buildings as well as the tallest structure in Latin America. Some fifty stories are to be devoted to office space and the top ten to luxury apartments. Ground breaking will take place soon, and it is estimated that the building will be ready for occupancy within the next year and a half.

Financing will be provided by a Swiss banking and investment firm, the Banque de Investimente Mobiliers et de Financement, with headquarters in Geneva. Architectural, engineering, and contracting services will be sought in the U.S.

Highway Engineers Urge Development of Simulators

The development of a variety of driving simulators to pre-test highway designs and traffic control devices is of high priority in the field of highway research, a conference of highway officials and research scientists has concluded. Such systems should be developed as quickly as practicable, the National Conference on Driving Simulators concluded recently, after three days of discussion, to avoid "imbedding in concrete" possible errors in design which could subsequently prove to be inefficient or even remotely dangerous to motorists.

A driving simulator is a device in which a subject, in a full-scale automobile, is subjected to realistic highway and traffic situations, usually projected on a motion picture screen ahead of him. The automobile is rigged to create the impressions of movement, acceleration, and braking experienced in a real car, and sounds of the motor and environment are recreated

to help make the test driver feel he is actually on the road. One of the objectives of the simulator is to permit scientists to observe driver reaction under various drugs and performance under various traffic conditions.

The objective of the recent three-day conference, held in Santa Monica, Calif., was to bring simulator experts and highway and traffic engineers together and let them determine what use might be made of such devices to improve highway design and traffic control systems.

The simulator experts, many of whom have been designing such testing devices for space satellites and supersonic aircraft, convinced the highway men that the simulator is a research tool of considerable merit. Of a number of random geometric design and traffic problems suggested by the highway engineers, all are logical subjects for pretesting with simulators, the scientists said. These problems include: (1) efficiency of various on-grade intersection designs; (2) efficiency of various interchange and ramp designs; (3) effect of various combinations of highway lighting; and (4) reaction of motorists to various signs, signals, and pavement markings.

The U. S. Bureau of Public Roads cosponsored the conference, with the Automotive Safety Foundation and the U. S. Public Health Service. State highway officials from several Western states also participated.

Foss Dam Finished

Completion of Foss Dam, on the Washita River in Southwestern Oklahoma, is announced by the U. S. Bureau of Reclamation. Construction of the dam began in October 1958 under a $7,351,557 contract awarded to the Wunderlich Contracting Company, of Palo Alto, Calif. The multi-purpose earthfill is 152 ft high, with a crest length of 18,000 ft. It impounds a reservoir with a capacity of 430,100 acre-ft.

In addition to its primary purpose of providing storage for municipal and industrial water supplies in the area, the new dam will irrigate Washita River bottom lands. Together with Fort Cobb Dam —a companion earthfill completed in November 1959—it will also serve as a flood-control project for the Washita Basin, which has a long history of destructive floods.

Japanese Utility Orders Record-Size Plant from U. S.

The Kansai Electric Power Company, of Osaka, Japan, has ordered a 325,000-kw steam-electric plant from the Westinghouse Electric Corporation. Valued at $20,000,000, the plant will be the largest and most powerful ever built for export from the United States. The order covers a tandem-compound reheat turbine-generator unit, other major electrical and mechanical apparatus, and engineering services for a power station to be built at Himeji.

Westinghouse will have prime responsibility for design of the station and has retained Gilbert Associates, Inc., of Reading, Pa., as engineers for the project. Babcock and Wilcox will supply a universal pressure boiler with a steam-generating capacity of over 2,000,000 lb per hr.

The new Himeji station will be located in the heavily industrialized Kobe-Osaka area on the southern coast of the main Japanese island of Honshu. One of Japan's largest privately owned and operated utility companies, the Kansai Electric Power Company serves Kyoto and six other major cities in addition to Kobe and Osaka.

Photogrammetrists and Surveyors Hold Annual Meetings

Upgrading to full professionalism and adequate education to sustain that status were principal subjects as the American Society of Photogrammetry (ASP) and the American Congress on Surveying and Mapping (ACSM) held consecutive meetings in Washington, D. C., in late March. It was the consensus that the change from competitive bidding to negotiation for jobs and fees where bidding has been common will involve problems that require a considerable amount of patient effort to solve.

Official actions of ACSM included: (1) a resolution affirming the need for early completion of basic surveys and maps of the U. S.; (2) a request that private surveyors and engineers be used in the agriculture conservation program; and (3) affirmation of its opposition to common-situs picketing. Groups at the meeting favored the NCSBEE Model Law, usually with some minor changes; the corporate idea is acceptable if all principals and stockholders are professionals as it lends continuity to a firm and its records.

Education became a controversial subject when Prof. M. O. Schmidt, F. ASCE, of the University of Illinois, advocated separating surveying instruction from civil engineering teaching. Professor Schmidt advocated two-year technician courses for most surveyors with specialists from a few graduate courses. ACSM's Education Division officially stated that Professor Schmidt's ideas were his own, not those of the Congress.

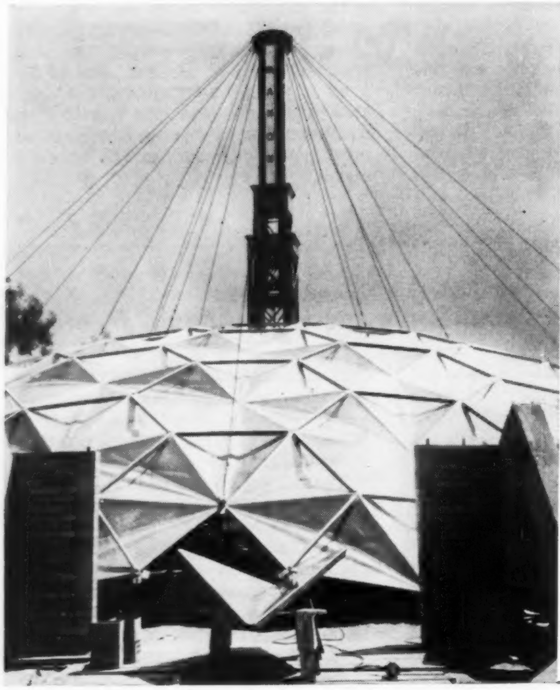
The Keuffel & Esser Fellowship, $1,000 for advanced study in Surveying, was awarded to James L. Clapp of Madison, Wis. The Wild-Heerbrugg Award of cash and use of an advanced theodolite for one year was given to Andrew Nagy. The Bausch and Lomb prizes for students went to W. H. Espey, at the University of Texas, and Pablo Larrea at Cornell.

Advanced surveying, mapping and photogrammetric equipment was on display at the meeting to update the nearly 3,000 in attendance on advancement in the art. Equipment shown covered the field from surveyors' tacks to rapid automatic plotters.

The technical sessions were just as broad as the displays, ranging from details on old-land surveys to mapping the moon. The need for the latter is closer than many people think, to be ready for contact with our lunar neighbor.

Brother B. Austin Barry, of Manhattan College, long active in ASCE's Surveying and Mapping Division, was installed as president of the ACSM. He succeeds Rear Admiral H. Arnold Karo, F. ASCE, of the U. S. Coast and Geodetic Survey.

Portable tower for surveyors, fabricated from tubular aluminum, weighs 10 lb per ft and can be transported and erected by helicopter. The separated inside tower isolates the theodolite from the support for the surveyor.



Aluminum Domes to House Building Product Exhibits

A thirty-city network of building product exhibit and market development centers is planned by Showcase, Inc., of Birmingham, Mich. The centers, to be called "Showcases," will be built in specially designed 64-ft-high Kaiser Aluminum Domes of 210-ft diameter, which will provide more than 35,000 sq ft of open floor space. The first (and headquarters) Showcase will be built in Detroit. The entire $22,500,000 construction program is scheduled for completion by next January. The R. C. Mahon Company, of Detroit and Torrance, Calif., is the fabricator and builder.

Peace Corps Studied at Colorado State University

Though most Americans have by now heard of the President's "Peace Corps" and have an idea of its purpose and significance, it is probably not generally known that preliminary feasibility studies were conducted by the Colorado State University Research Foundation under Dr. Maurice Albertson, F. ASCE, director of the Foundation. Before the Corps was established, the Foundation delivered to President Kennedy a strong recommendation for formation of a "youth corps" of young Americans to aid less-developed countries on a people-to-people rather than a government-to-government basis.

Dr. Albertson made his preliminary report to the administration after weeks of concentrated feasibility tests involving interviews, questionnaires, studies in depth of key problems, and staff field trips to ten foreign countries. The studies were made under contract with the International Cooperation Administration.

The 30-page report urged that the corps be composed of young men and women in the 20-30 age group; that the corps not be considered a draft alternative; that activities abroad be governed by a board of persons from both the U. S. and the host country; and that the board be given maximum autonomy.

In his recommendation, Dr. Albertson placed strong emphasis on utilizing the services of many agencies which already have overseas technical assistance programs involving youth. He proposed that corpsmen be paid subsistance, plus a modest spending allowance sufficient for health and morale "but not enough to live in a manner inconsistent with that of the host country people with whom he is working." It was also suggested that the corpsmen be workers rather than advisory-level technicians or experts. Each corps member should have some ability or skill in short supply in the host country, Dr. Albertson said, and cultural exchanges should be a secondary objective.

In a recent interview Dr. Albertson suggested that the program might begin in such countries as Nigeria or the Philippines, where teachers of English are needed, or in Chile, where workers may be needed to help rebuild communities damaged by last year's earthquake.

He also said that in addition to college graduates the program should include persons who have only completed high school.

He noted that many persons who have not been to college have skills in the building trades and in agriculture that can easily be utilized in the underdeveloped countries of Asia, Africa and Latin America. It has also been suggested that newly independent countries need engineers as well as trained technicians.

Urban Study Center To Advise Venezuela

An agreement has just been completed between the Government of Venezuela and the Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University for research and technical assistance in the Guayana region of Venezuela.

In cooperation with Venezuelan officials and experts, the Joint Center will analyze the economic structure and potential of the region as a basis for determining requirements for housing, for commerce and industry, for public services including utilities and transportation, and for the pattern of urban and regional growth. The Joint Center will also prepare a comprehensive plan for the design of a new city, probably to be called Guayana City. This phase of the work will be carried out in cooperation with the Venezuelan Guayana Corporation.

The Guayana region, centered on the confluence of the Orinoco and Caroni Rivers in southwestern Venezuela, has such a unique combination of resources that it is called the Ruhr of South America. There are rich deposits of iron and manganese ore, bauxite, and petroleum in the area. A new hydroelectric plant is already producing low-cost power. A steel mill is being built and will be managed by Koppers. The Reynolds Metal Company and the Government of Venezuela will build an aluminum plant, and a petrochemical plant and other factories are planned. An estimated 45,000 people have already moved into the region in anticipation of the industrial development.

The Joint Center is a research organization established in 1959 by M.I.T. and Harvard. Its principal function is to stimulate fundamental and applied research in urban and regional studies. Members of the Joint Center are drawn from the faculties of both institutions, and from a variety of academic disciplines.

N. Y. Contractor to Build Kentucky Sewage Plant

The Malan Construction Corporation, of New York, has presented a low bid of $2.6 million for modernization and extension of the Lexington, Ky., sewage treatment plant. Award of the contract awaits only land acquisition by the city.

The project, which is part of a $7,000,000 municipal sanitary facilities expansion program, will include construction of two 75-ft-dia prestressed concrete digester tanks; a digester control building; aeration, nitrification, and settling tanks; primary sludge and effluent pumping stations; a grit chlorinator; and blower and administration buildings. Existing facilities will also be modernized. When the project is completed, the plant will have a treatment capacity of 12 mgd.

Consulting engineers on the expansion project are J. Stephen Watkins, F. ASCE, and Howard K. Bell, both of Lexington.

Construction Spending Rises in March

The value of new construction put in place this March totaled $3.9 billion, according to preliminary estimates of the Bureau of the Census of the U. S. Department of Commerce. This amount represented a seasonal 8 percent rise over February spending and was at about the same level as March 1960 expenditures.

Contributing to the March 1961 total were private construction expenditures of $2.8 billion—up 7 percent from February (6 percent is normal) but down 4 percent from March 1960 spending. Though spending for construction of private nonfarm residential buildings totaled $1.4 billion, an increase of 10 percent over February expenditures, this amount was 11 percent under last year's level for the month. The $1.1 billion going for public construction this March was 10 percent above the February level and 13 percent above March 1960 expenditures.

Total construction spending in the first three months of this year came to $11.3 billion, just about the same as spending in the comparable period of 1960. Comparative estimates for this first quarter show a decline of 5 percent in private construction expenditures over last year but a rise of 14 percent in public construction.

New Steam-Electric Plant To Be Built on the Ohio

The largest steam-electric generating plant ever built by an investor-owned public utility will be constructed at Lawrenceburg, Ind., on the Ohio River, by the Indiana & Michigan Electric Company, a major operating company of the American Electric Power System. The $73 million, 580,000-kw unit will be the fourth at the company's Tanner Creek Plant at Lawrenceburg. Construction will start this summer, with completion expected by the spring of 1964.

The new facility will be designed to operate at a heat rate of about 8,500 Btu per kilowatt-hour of net generation, said to be a new record for efficiency in the conversion of energy from coal into electrical energy. The unit is expected to burn about 1,600,000 tons of coal annually, which will be delivered by river barge.

U. S. Loans Made for Projects in Peru

Loan agreements for $20,000,000 have been signed by the Export-Import Bank of Washington and the Government of Peru to finance the purchase of U.S. equipment for two road projects in Peru. Of the amount $12,000,000 will go for improvement and completion of the Northern Trans-Andean Highway, extending from Olmos to Yurimaguas. The rest of the loan will be used in development of access roads in the Upper Selva area on the eastern slopes of the Andes in southern Peru.

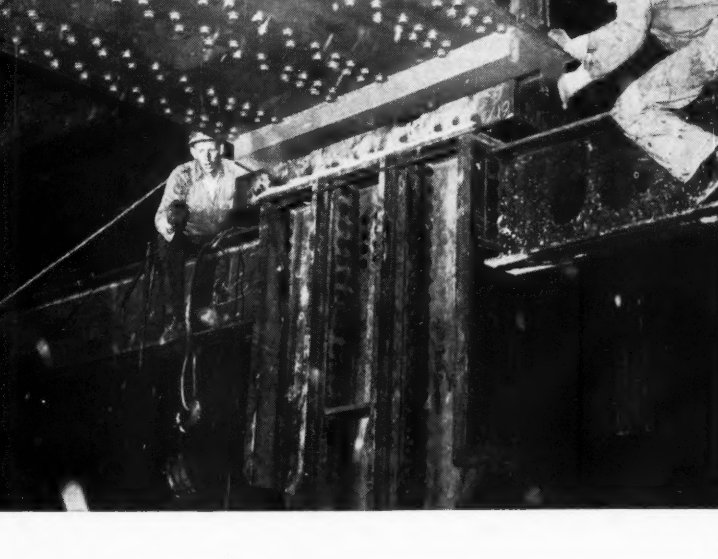
Wind Tunnel for Testing Space Vehicles

A $1,384,780 contract for fabrication of an 8-ft high-temperature structures tunnel has been awarded to Pittsburgh-Des Moines Steel by the National Aeronautics and Space Administration. Scheduled for completion in January 1962, the new wind tunnel will be used to test space flight vehicles at NASA's Langley Research Center, Hampton, Va. Research at Langley field is currently devoted to solving problems associated with space flight and reentry of vehicles.

Fabrication of the Mach 7 (seven times the speed of sound) high-temperature blowdown tunnel involves a test section, diffuser, and ejector. It includes a high-pressure air storage system, a gas-fired combustion chamber for generation of temperatures up to 4,000 deg F., data-recording equipment, and a shop for preparation of test models.

Night Work on George Washington Bridge Bus Station

In an all-night construction operation at the George Washington Bridge Bus Station this steel girder, 83 ft long and weighing 130 tons, was placed across Fort Washington Avenue in the block between 178th and 179th Streets to connect the new station with the bridge. Two lighter girders—about 100 ft long and weighing 30 tons apiece—were also placed, together with connecting beams, across Fort Washington Avenue to form the center section of the bridge overpass. Operation was handled by the Bethlehem Steel Co. The roof of the bus station will be the United States' first example of the work of Dr. Pier Luigi Nervi, noted Italian engineer-architect. It will consist of 26 triangular sections, of which 14 slope upward from a row of columns in the center of the building. Each triangular 92- by 66-ft section will be made of 36 concrete panels.



ASCE Member Made New Army Chief of Engineers

Maj. Gen. Walter K. Wilson, Jr., F. ASCE, Commanding General, U.S. Army Engineer Center, Fort Belvoir, Va., has been nominated to be Chief of Engineers, U.S. Army. He has also been nominated for promotion to Lieutenant General. In the Corps of Engineers since his graduation from West Point in 1929, General Wilson has been district engineer at St. Paul, Minn., Mobile, Ala., and Atlanta, Ga., and division engineer for the South Atlantic and Mediterranean Divisions. Since 1956 he has been Deputy Chief of Engineers for Construction, with the rank of Major General.

General Wilson succeeds Lt. Gen. Emerson C. Itschner, F. ASCE, who has left for Pakistan where he will be chief technical adviser on the Indus River Project for the Harza Engineering Company.

February Steel Picture

February shipments of finished steel products totaled 4,250,720 tons—compared with 4.6 million tons shipped during January (a 31-day month) and with 7.6 million tons shipped during February a year ago. The principal markets to which steel was shipped in February were: (1) warehouses and distributors, 751,196 tons; (2) automotive, 690,770 tons; and (3) construction, including maintenance, 572,942 tons.

Stone Laying for Tigris River Bridge

Placing of a foundation stone at the site of the Karradah Bridge in Baghdad, Iraq, took place recently in ceremonies headed by Prime Minister Abdul Karim Kassim and other government officials. The bridge will be a self-anchored suspension structure spanning the Tigris.

Steinman, Boynton, Gronquist & London, of New York, are the consulting engineers, with R. M. Boynton in charge of the project. Murray I. B[illegible]ll, M. ASCE, is their resident engineer.

Austin Company Forms Two Foreign Firms

The Austin Company, international engineering and construction firm with general offices in Cleveland, has announced the formation of two new firms in Australia and Argentina, through which it will provide interested American companies with a complete range of design, engineering, construction, and consulting services. The new firms are jointly owned by Austin and well established local engineer-builder organizations whose familiarity with local conditions will supplement the experience of Austin executives and engineers who have been permanently assigned to the two countries.

Austin-Anderson (Australia) Pty. Ltd., with headquarters in Sydney, Australia, and an office in Melbourne, will have as its managing director, A. J. Anderson, founder and managing director of A. J. Anderson (Australia) Pty. Ltd., Australia industrial building specialists.

The new firm of Austin-Graziani, S.A., with headquarters in Buenos Aires, Argentina, is jointly owned by Austin and the Graziani family, widely known for its engineering and construction activities in the Argentine. Luis J. Graziani, president of the new firm, is a civil engineer and one of the principals of Luis R. Graziani e Hijos S.R.L., one of Argentina's leading design and construction firms. Austin is already building a large new plant in the Argentine for the International Division of the Ford Motor Company.

EXAM GEMS

by Reggie Strashw

R. ROBINSON ROWE, F. ASCE

A cylindrical tank made by welding 7-ga bottom plate to a corrugated iron pipe 6 ft in diameter by 5 ft high is supported along its perimeter. Cast in the lower half of the tank is a mass of cemented gravel, weighing only 120 pcf, it being permeated by large connected voids or cells occupying 20 percent of the bulk volume and thru which water can pass freely. When the tank is filled with water, what is the unit pressure on the bottom of the tank at the center?

Unlike its antecedent, Examgem 22 had gravel which wouldn't float, it being heavier and cemented. It was not hard to compute the weight of material over each square foot of the bottom: 300 lb of cemented gravel, 31 lb of water in its voids, 156 lb of water over it; total 487 lb. Now let's see how various minds reconciled these data with the context.

Zack Zilch was a conservationist. The cemented gravel had been poured on the bottom and was still there. The water couldn't hang on the sides of the tank, so by the principle of conservation of mass, his answer was 487 lb.

Yancey Yocum visualized the voids as he would for uplift on dams. The 300 lb was supported on 80 percent of the bottom and the other 20 percent the pressure of a 5-ft head of water. Total, 362 lb.

Xavier Xelph saw the cemented gravel as a slab bonded to the corrugated side of the tank, so that the bottom supported only the water—187 lb.

Willy Wise considered the history of the slab. Poured on a 7-ga plate, the latter would have deflected to a spheroidal belly. Because of its elasticity, it would continue to press against the slab with a force of 300 psf until a greater load increased the deflection. Then the plate would separate from the slab, shifting the weight to the perimeter, and water would underrun the cemented gravel. With water in contact with all of the bottom plate, the pressure on it was 312 psf.

Val Voyd left a blank page, so you'll have to guess what was in his mind—if anything. In the scoring of 400-odd applicants, 30 percent were Vals, 50 percent were Zacks, 10 percent were Yanceys or Xaviers, and only 10 percent were Wise. From a statistical viewpoint, these results were disappointing, but even more disappointing is the conclusion that so many applicants hope to pass on a combination of formulas and arithmetic, and class little gems like this as "catch" questions because a little thinking was required.

Thinking of a different sort was valuable for many who tackled our next problem and ran into a differential equation.

EXAMGEM 23

A tank containing 100 gal of fresh water has an inflow of brine with 1.0 lb of salt per gal at the rate of 3 gpm, and an outflow of well-diffused mixture at the rate of 2 gpm. How much salt is in the tank after an hour?

As an academic problem, the set-up is not difficult. Letting x equal the weight of salt in the tank and v equal the volume of water in the tank at any time t in minutes, so that the salt concentration at any time is x/v, the rate of increase of salt is the difference between inflow and outflow:

$$\frac{dx}{dt} = 3 - \frac{2x}{v} \quad \ldots\ldots\ldots\ldots\ldots (1)$$

$$v = 100 + 3t - 2t = 100 + t \quad \ldots (2)$$

$$dv = dt$$

$$\frac{dx}{dv} = 3 - \frac{2x}{v} \quad \ldots\ldots\ldots\ldots\ldots (3)$$

$$xv^2 = v^3 - C \quad \ldots\ldots\ldots\ldots\ldots (4)$$

$$C = 1{,}000{,}000$$

so that when $t = 60$, $v = 160$, and $x = 120.875$ lb.

However, only one of 142 candidates succeeded in solving the differential equation (3). The solution next month will show the resourcefulness of many others whose math was rusty but brains well oiled.

Cubic DM-20 Electrotape system quickly pinpoints location of off-shore installation.

ELECTROTAPE WORKS WHERE CHAIN AND TAPE WON'T: The new, lightweight, all-transistorized version of Cubic Electrotape, Model DM-20, marks a major breakthrough in the art of surveying. Electrotape eliminates time-consuming chain and tape work, and lets even unskilled operators measure distances from 150 feet to 40 miles in just a few minutes per set-up. Easily operable by one man, the DM-20 weighs only 25 pounds. Its accuracy is 1 centimeter plus 3 parts per million, and the front panel readout is directly in centimeters, eliminating scope or meter interpretations. The DM-20 operates day and night, in any weather, with a built-in radio-telephone permitting communication between operators at all times. A single tripod-mounted unit incorporates the recessed parabolic antenna, regulated power supply, compact battery, and electronic circuits. Write for descriptive literature to Dept. CE-102, Industrial Division, Cubic Corporation, San Diego 11, California.

cubic CORPORATION

INDUSTRIAL DIVISION
SAN DIEGO 11, CALIFORNIA

New in education

Dr. Humphreys at Cooper Union

A leading scientist in the nuclear field, Dr. Richard Franklin Humphreys (see photo), has been appointed president of *Cooper Union* in New York City—the nation's oldest tuition-free private college of engineering, art, and architecture. He succeeds Dr. Edwin S. Burdell, who retired last February after 22 years as director and president, to become president of the Middle East Technical University in Ankara, Turkey. Dr. Humphreys is currently vice president of the Armour Research Foundation of the Illinois Institute of Technology at Chicago and it was largely through his efforts that the Foundation was able to enter the nuclear reactor field and to install the world's first reactor for industrial research.

Summer sessions

This summer short courses are the "thing" in engineering schools across the country.

As in the past, the *Georgia Institute of Technology's Department of City Planning* will continue in 1961 the program it has held in cooperation with other Southeastern universities for the past several years. This year the two-week basic course, to be held July 17 through July 28, for a fee of $150, will be of particular interest to those who have just entered the city planning field and who wish a survey of the many areas covered in city planning. This will be followed by the Advanced Institute in Zoning which will meet from July 24 through July 28, at a cost of $100. Some of America's top authorities in the field of city planning and urban development will be on hand for this one-week program which is designed for planning directors and others who have had considerable experience in the field. Further information may be obtained from the Director, Short Courses and Conferences, Georgia Institute of Technology, Atlanta 13, Ga.

Joseph Marin, professor and head of the department of engineering mechanics at *Pennsylvania State University*, is chairman of a short course on solid state mechanics to be given at the University June 11 through 23. Dr. Marin in his lectures will emphasize recently developed methods for evaluation and interpretation of stress-strain properties and the use of these procedures in design. Information from Engineer Seminars, Conference Center, Pennsylvania State University, University Park, Pa.

Instruction for sewage plant operators will be provided June 5-7 by the Technical Extension Services at *Washington State University* and will be geared to three different levels—elementary, intermediate and advanced—based on individual experience and training. Anyone desiring further information concerning the Seventh Sewage Works School should write to William H. Knight, Head, Technical Extension Services, Washington State University of Technology, Washington State University, Pullman, Wash.

With the rapid advances in the basic sciences there is now developing a science of materials stemming from principles deduced from the nature and behavior of a wide variety of substances. *Iowa State University* will sponsor a six-week summer institute, carrying graduate credit toward advanced degrees, for teachers of engineering, on the properties of engineering materials, July 13 through August 23. The institute has been made possibly by a grant of $45,700 from the National Science Foundation.

Advanced concepts and techniques for the treatment of highway planning and design will be the subject of a one-week special summer program to be held at the *Massachusetts Institute of Technology* from August 14 through August 18. The program will be under the general direction of Professor A. J. Bone, F. ASCE, of the Transportation Engineering Division; guest lecturer will be John Clarkeson, F. ASCE, of the Clarkeson Engineering Company, Inc.; and Professors A. S. Land and Martin Wohl of the Transportation Engineering Division and Professor P. O. Roberts of the Data Engineering Division will conduct the courses. On the subject of the sheer strength behavior of cohesive soils, M.I.T. will hold a second summer program, August 28-September 8. The program is designed to provide educators, researchers, and practicing engineers with a comprehensive understanding of the latest developments in the area of cohesive soils. Dr. T. William Lambe, F. ASCE, professor and head of the Soil Engineering Division, will direct the program which will also include M.I.T. staff members, Professor R. V. Whitman, M. ASCE, and Messrs. C. C. Ladd, A.M. ASCE, and R. M. Harkness. Dr. R. E. Gibson, lecturer in civil engineering at the Imperial College of Science and Technology, London, England, will be a guest lecturer. Inquiries regarding admissions, tuition and other details should be made to the Director of the Summer Session, Massachusetts Institute of Technology, Cambridge 39, Mass.

Pathfinders

Research expenditures at the *University of Michigan* for the second year in a row topped $25 million in 1959-1960. Overall, the "Engineering College Review of 1959" ranked the University of Michigan first nationally in expenditures for research in engineering closely allied with educational activities. Down through the years the University of Michigan has had many "firsts" among higher educational institutes in the United States. Of interest tô engineers in 1853 was its decision to have a professor of physics and civil engineering; followed in 1854 by a program in engineering leading to a degree, the first such program in the West. In 1913 it initiated instruction in aeronautical engineering and automotive engineering, and nine years later, in 1922 established a professorship in transportation engineering. In recent years Michigan has led the field in nuclear engineering (1952) and in engineering meteorology (1959).

Cornell University broke from the traditional pattern of four-year engineering education in 1946 when all of its engineering curricula were extended to five years. Now, starting with the 1961 fall term all entering engineering students will be enrolled in the new Division of Basic Studies. The courses in the two-year basic studies program, according to Professor Dale R. Corson, dean of the College of Engineering, will "provide maximum opportunity for the student to become familiar with the range of professional programs available to him in the last three years of study in Cornell's five-year engineering program," thereby establishing a sound basis upon which the student can ground his preference.

Two years after it initiated nuclear engineering training at the master's level, the *University of Illinois* has extended the program to the doctoral level. Since nuclear engineering makes use of knowledge from diverse areas of engineering and science the new program, like the existing master's program, will be directed by a committee with members of the graduate faculty from all departments of the College of Engineering. It anticipates a growing need for trained nuclear engineers for research, design, and operation in virtually all fields of industry, research, and the nation's defense effort.

For a 4 cent stamp

The Correspondence Department of the *University of California Extension* is offering a new 3-credit course in "Mechanics of Materials." The mail course will be conducted by H. Donald Yorston, M. ASCE, design engineer for the Bechtel Corporation, and is based on a textbook by Egor P. Popov, M. ASCE, professor of civil engineering and director of the University of California Structural Engineering Laboratory. The fee is $24 for California residents and $28 for out-of-state enrollees. Write to the Department of Correspondence Instruction, University Extension, University of California, Berkeley 4, Calif.

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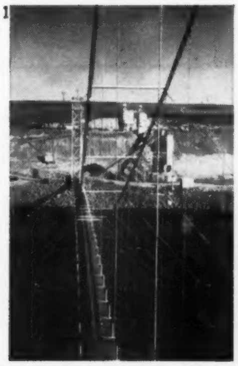

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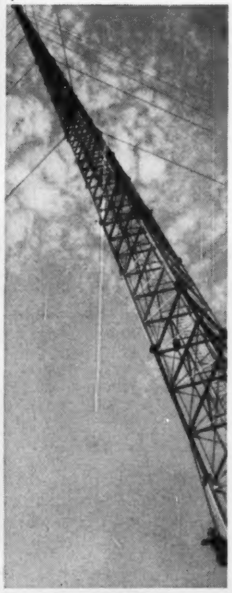

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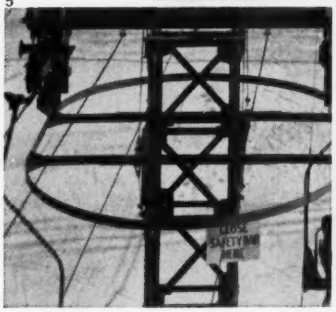

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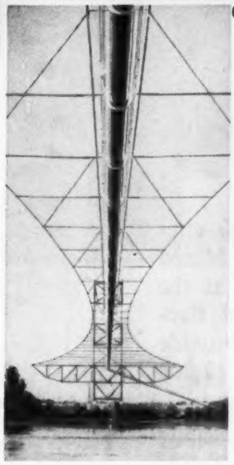

7

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Answers to Quiz:

1) *Conveyor Bridge at Pasco, Washington,* 2) *Gymnasium with suspended roof at Central Washington College of Education, Ellensburg, Washington,* 3) *Cable-stiffened suspension San Marcos Bridge, El Salvador,* 4) *1619-ft TV Tower at Portland, Maine,* 5) *Mt. Sunapee Chairlift,* 6) *Pipeline Suspension Bridge, Blythe, Cal.,* 7) *Footbridge with prestressed concrete floor, Lumberville, Pa.*

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DECEASED

G. Walker Burgess (M. '58; F. '59), age 51, had been general engineer in charge of utilities and rates computation in the utilities and engineering branch of the Department of Public Works at China Lake, Calif. In recent years he was a public utility engineer with the Southern California Gas Company; an engineer for the Fortana Union Water Company; and city engineer and then city manager of Delano, Calif.

Arthur A. A. Carman (A.M. '21; M. '59), age 82, for the past 38 years had maintained a consulting practice in Brooklyn, N.Y. A native of England, he was employed early in his career by the English firms of Fulham Steelworks Company and later by the Building Construction Company as chief designer and field engineer. Once in the United States he joined the John S. Metcalf Company in Chicago, which he left after four years to go to the New York office of the Austin Company.

K. Philip Coykendall (M. '45; F. '59), age 60, at the time of his recent death, was superintendent of the Hanover (N.H.) Water Works Company and a member of the board of directors. In 1940, he joined the U.S. Navy and began a career which lasted for more than 15 years, during which time he served as public works officer at various Naval bases. His last tour of duty was as executive officer of the 30th Naval Construction Regiment, Civil Engineer Corps.

Swan A. Erickson (A.M. '30; M. '59), age 58, since his student days at the Universiy of Arizona when he did double duty as campus engineer, had served in various design capacities with private concerns before joining the office of Arizona's State engineer as bridge designer. Most recently he was engineer of bridges and dams with the Arizona State Highway Department in Phoenix.

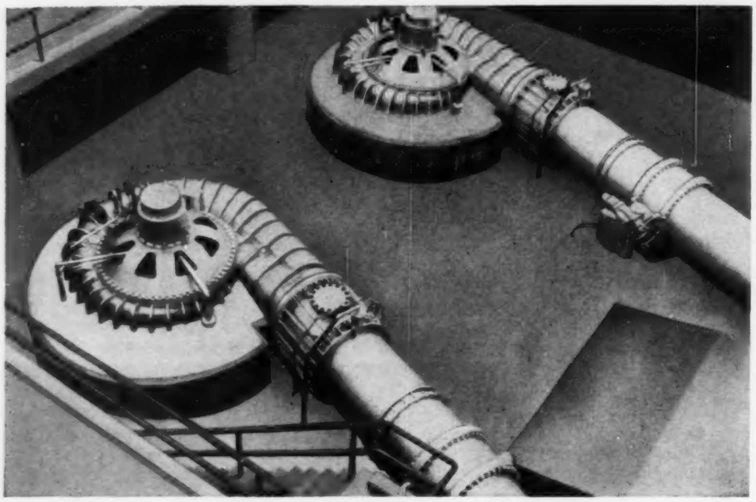
Almon H. Fuller, (M. '10; F. '59), age 89, professor emeritus of civil engineering at Iowa State University where for many years he headed the civil engineering department, died on March 31 in Des Moines, Iowa. From 1898 to 1917 Dr. Fuller served as professor of civil engineering at the University of Washington, and for most of those years was also dean of engineering there. Author with Frank Kerekes, of Iowa State, of a textbook entitled "Analysis and Design of Steel Structures," he also wrote a number of research bulletins and reports on various fields of engineering. He was a former president of the Iowa Section.

Calvin Nelson Harrub (M. '24; F. '59), age 80, had retired in 1959 after 36 years as founder and head of the C. N. Harrub Engineering Company, in Nashville, Tenn. During his career he had two engineering "firsts," as the first sanitary engineer for the State of Tennessee and the first for the City of Nashville.

Coleman L. Hasie (A.M. '28; M. '59), age 64, longtime consulting engineer of Lubbock, Texas, was most recently a partner in the consulting engineering firm of Hasie & Green and Associates in Lubbock. He was a retired Lieutenant Colonel, having served in both world wars.

Randolph C. Higgins (A.M. '45; M. '59), age 53, before forming the R. C. Higgins Engineering Company in Florence, S.C., in 1953, had served there as a Captain in the Army Corps of Engineers. Early in his career he was engaged in designing and supervising drainage for malaria control work as

(Continued on page 100)



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The C. H. Wheeler Dual Volute design is especially valuable when a pump is required to operate over a wide range of operating conditions.

Both pumps have side discharge. An unusual C. H. Wheeler designed bottom suction permits taking water from the same penstock that drives the Water Turbines.

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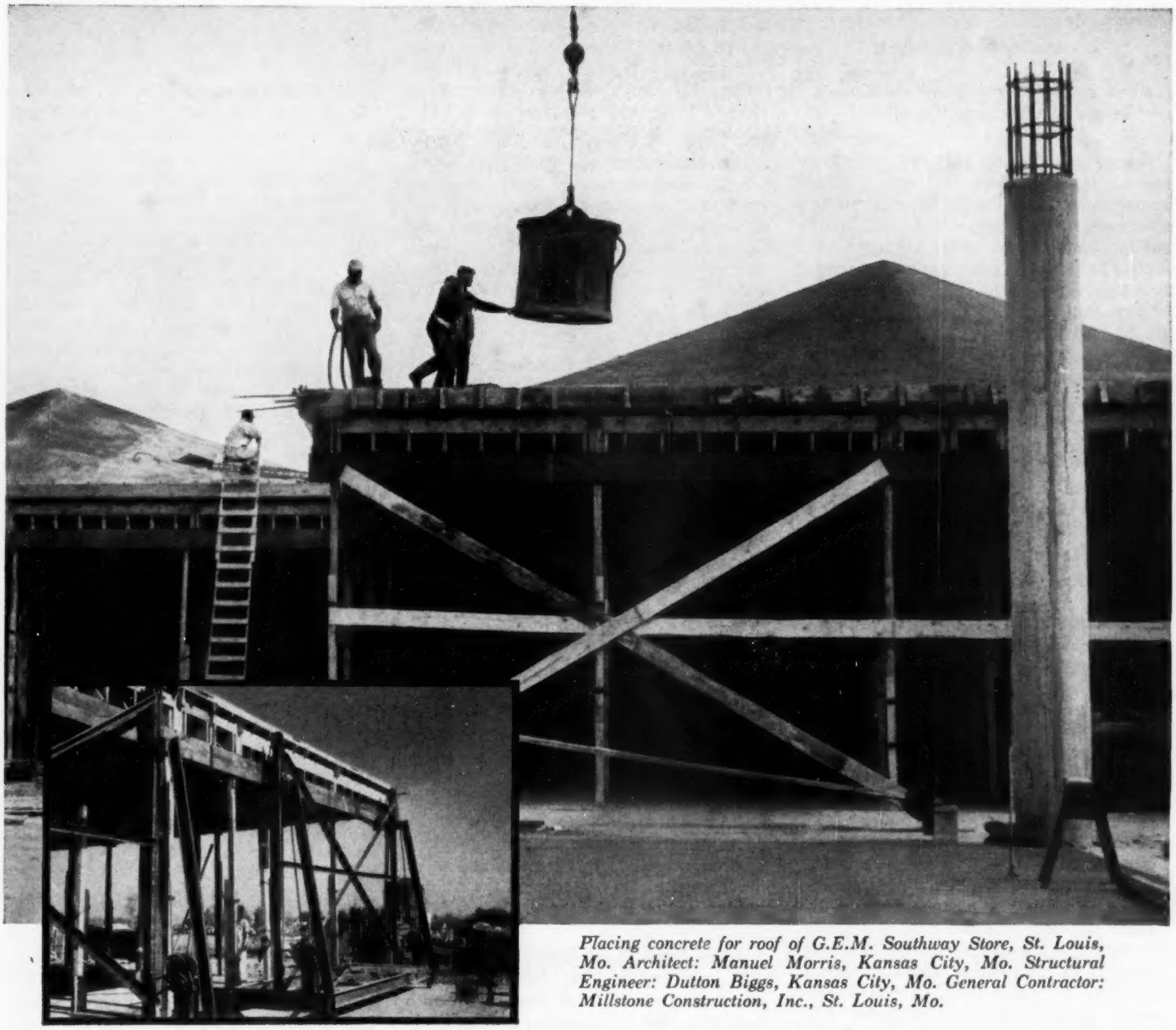

Special lifting device raising formwork

Placing concrete for roof of G.E.M. Southway Store, St. Louis, Mo. Architect: Manuel Morris, Kansas City, Mo. Structural Engineer: Dutton Biggs, Kansas City, Mo. General Contractor: Millstone Construction, Inc., St. Louis, Mo.

Only 6 weeks needed to roof 120,000 sq. ft. store with concrete hyperbolic paraboloids

In the building of the new G.E.M. Southway Department Store, St. Louis, doors opened for business just 85 working days after award of the construction contract. A major reason for the record-time completion of this one-story, one-area shopping center lay in the concrete shell roof.

The roof is composed of 50 reinforced concrete hyperbolic paraboloids. Each of these umbrella-shaped shells is supported by a 24-inch diameter concrete column. Through the efficient re-use of only 5 sets of forms, sizable savings in both time and labor were effected. All 50 shells, each 47½ ft. square and 2½ inches thick, were completed within 6 weeks.

Construction of the hyperbolic paraboloids was done in rows. Thus, masonry, plastering and other trades began work as soon as a row was completed.

This is another good example of the way improved techniques have made shell roof designs economically practical for structures of all types and sizes. No wonder structurally strong concrete is the choice of more and more engineers and builders! Write for technical facts. (Free in U.S. and Canada only.)

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FOR STRUCTURES... MODERN concrete

A national organization to improve and extend the uses of concrete

Deceased

(Continued from page 98)

malaria control engineer for the County of Georgetown in South Carolina.

Victor F. Lawson (M. '42; F. '59), age 64, in recent years had been a sales engineer with the Porete Manufacturing Company at Winchester, Mass., after similar employment with Anchor Concrete Products, Inc., and Barten & Wood, Inc. During the early 1950's he was general manager of the Lawson Manufacturing Company at Wakefield, Mass.

Alexander Lyle (M. '33; F. '59), age 69, for the past four years had been superintendent of the Underpinning and Foundation Company, Inc., New York City. Before that he was general superintendent of the George H. Flinn Corporation for six years and chief engineer of the Carleton Company, Inc., for 14 years.

Richard C. Marshall, Jr. (M. '19; F. '59), age 82, was a consulting engineer in Washington, D.C., for more than 30 years. He joined the Army immediately after graduation from Virginia Military Institute in 1898, and was later appointed commandant there. Since his retirement from the Army with the rank of Brigadier General at the conclusion of World War I, he had maintained consulting offices first in Chicago and New York and later in Washington.

Roy E. Miller (M. '21; F. '59), age 76, civil and mining engineer, of Punxsutawney, Pa., and a partner in Roy E. Miller and Son, was the first to develop the method of hydraulic dredge for construction of earth-filled dams. Between the years 1929 and 1941, he was a consulting engineer for various firms, primarily in the public utilities field.

Elmo Neil Murphy (A.M.'21; M. '59), age 72, from 1920 until his retirement in 1953, was affiliated with the Pacific Gas and Electric Company in San Francisco, Calif. During that period he specialized in the design of hydroelectric projects and was instrumental in reviewing designs of existing Company dams when all major dams in California were placed under State supervision.

Harold King Palmer (M. '27; F. '59), age 82, who retired in 1948 as office engineer after 23 years with the Los Angeles (Calif.) County Sanitation Districts, had served earlier as a civil engineer in the U.S. Indian Service for some 20 years. He had a part in developing the Palmer-Bowlus Flume, which is extensively used in the West for measuring sewage flow.

Horace B. Perry (M. '29; F. '59), age 67, since 1920 had been associated with Jackson & Moreland, Inc., consulting engineers of Boston, Mass. Mr. Perry's work largely had to do with financial and economic studies for public utilities. Following the firm's incorporation in 1956, he was made a vice president and placed in charge of the Valuation and Appraisal Division, as well as the Technical Publications Division. He was promoted in 1958 to senior vice president of the firm.

Harrison V. Pittman (M. '21; F. '59), age 79, had retired in 1951 after 44 years as an engineer for the Army Corps of Engineers. In his last years with the Corps he was engaged in the construction of Nimrod, Blue Mountain, Clearwater, Norfork and Bull Shoals dams for the Little Rock District.

Wilfred Van Nest Powelson (M. '15; F. '59), age 87, from 1919 until his retirement in 1944 was a Lieutenant Commander in the United State Navy. Prior to and following his service in the Navy, he maintained a private consulting practice in New York City.

De Witt Lee Reaburn (M. '09; F. '59), age 89, 37 years ago built Mulholland Highway in California (now Mulholland Drive). He first gained national fame around the turn of the century when he headed a topographic expedition which traveled 2,000 mi by canoe mapping and naming all the glaciers and mountain peaks along the west base of the Alaskan range. Subsequently, he also fixed the height of Mt. McKinley at 20,300 ft, a figure still used today. Then in 1932, he joined the California Metropolitan Water District where he served as superintendent of tunnel construction for the Coachella area and as superintendent of the Thousand Palm Camp on the Metropolitan Water District Aqueduct.

John Franklin Reynolds (M. '38; F. '59), age 76, in 1941 was a founding member of the firm of Reynolds, Smith and Hills, of Jacksonville, Fla., actively participating in the consulting engineering activities of that firm until his retirement in 1958. Major projects included such local works as the design and construction of the Lynch Building and the Alsop Bridge across the St. John's River, in addition to Treasure Island Causeway near St. Petersburg, Fla., and the municipal harbor in Clearwater, Fla.

George N. Robinson (M. '36; F. '59), age of 67, from 1922 to 1955 was president of the Equity Construction Company, Inc., of New York, and from the latter year until his recent death was a partner in Cowell and Robinson, also of New York. In the former position he directed the engineering and construction of numerous industrial, commercial and public buildings.

Henry Preston Rust (M. '13; F. '59), age 80, at the time of his recent death was an industrial engineer with United Engineers and Constructors, of Philadelphia, Pa., for ten years. Before that he served the Cramp interests on two separate occasions; first, from 1919 to 1924, as plant engineer of the William Cramp & Sons Ship and Engine Building Company, and, again, from 1941 to 1951, as plant engineer of the Cramp Ship Building Company.

E. C. Sherman (M. '10; F. '59), age 84, a retired project manager with the Navy's Bureau of Yards and Docks in Washington, D.C., had previously been in charge of designing the dams and spillways for the Panama Canal at the Gatun and Miraflores locks near Culebra. At the completion of his duties there in 1912, he returned to Boston—where he had earlier been engaged on work for the Charles River Basin as division engineer—and engaged in private practice for several years. Then in 1917, he was given a civil service appointment by the Navy Department in the Bureau of Yards and Docks from which he retired in 1936 as project manager.

Everett W. Smith (M. '46; F. '59), age 63, who joined the Owens-Corning Fiberglas Corporation in 1949 as director of merchandising, was a vice president of the firm when he died recently. Previously, he was vice president of sales for the Philip Carey Manufacturing Company.

Ernest Joseph Straub (A.M. '21;M. '59), age 67, in 1921 became manager of the E. J. Straub Company, contractors and builders of Kansas City, Mo., and remained with that firm until his death.

J. R. Taft (M. '22; F. '59), age 82, retired civil engineer of Geneseo, N.Y., began specializing in railroad engineering very early in his career, serving as assistant engineer with the Pennsylvania Railroad in construction of rock tunnels under the Palisades in the Bergen Hill Section of New Jersey. More recently he was chief engineer of the Geneseo and Wyoming Railroad at Retsof, where earlier he had had charge of surveying and designing a 16,000,000-gal reservoir for the Retsof Mining Company.

L. Vernon Uhrig (A.M. '32;M. '59), age 56, having joined the production research department of the Humble Oil & Refining Company in Houston in 1936, rose in the ranks until his last promotion as senior research specialist. In this capacity he developed and supervised studies of the operation of subsurface pressure gauges and thermometers in oil wells. These studies led in turn to his most important accomplishment the borehole thermometer.

Robert H. Whipple (A.M. '14;M. '59), age 77, a lifetime employee of the American Gas Company of Philadelphia, had been in retirement for several years. His first job with the gas company was as assistant engineer in charge of Operation, Construction and Valuation of gas and electric plants. This was followed—after American Gas merged with the United Gas Improvement Company and the Philadelphia Electric Company was purchased by U.G.I.—by promotion to superintendent of gas production with the Philadelphia Electric Company.

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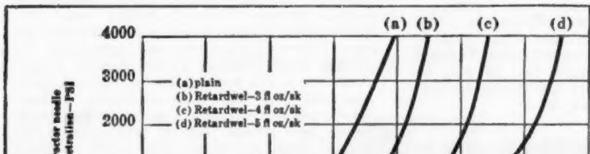
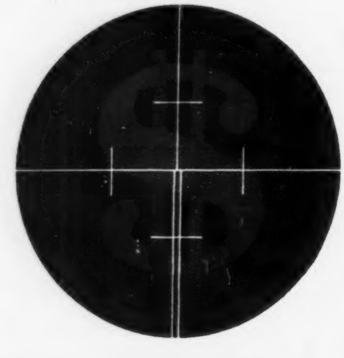


DOWN TO FUNDAMENTALS



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New Publications

Water pollution conference . . . . Two valuable publications have come out of the National Conference on Water Pollution, held in Washington, D. C., last December. Highlights and recommendations are contained in a 48-page summary report, "Clean Water: A Challenge to the Nation," which is available from the U. S. Public Health Service, Washington 25, D. C. The full conference proceedings and texts of papers delivered make up a 600-page volume —identified as PHS Publication No. 819—for sale by the Superintendent of Documents, GPO, Washington 25, D. C. The price (in paper) is $2.25.

Road records . . . . "Road Experience Records"—one of a series of procedure manuals issued by the National Association of County Engineers—contains information on how to establish a system of cost accounting. Initially, this involves identification of each road and road structure. Road equipment is then designated and identified, and uniform definitions for road work are set forth. The manual, priced at $3.00, is available from the National Association of County Engineers, 200 Ring Building, Washington 6, D. C.

Single contract construction . . . . Contract-awarding authorities from private industry and from all levels of government are quoted as supporting the single-contract method of construction in a new brochure, entitled "Save Construction Dollars with America's Basic Construction Method, the Single Contract System." Single copies are available without charge from the Associated General Contractors, 1957 E Street, N. W., Washington 6, D. C.

Building research, Canada . . . . Advances made in building research in Canada in 1958 and 1959 are currently reported by the Division of Building Research of the National Research Council in a bulletin identified as NRC 5743. The report was prepared as a supplement to the recently issued record of the first decade of operation of the Division of Building Research. Copies may be obtained from the National Research Council, Ottawa, Canada, at $1.00 each.

Airport structures . . . . The Federal Aviation Agency has prepared two booklets for the guidance of architects, engineers, and others concerned with the development of plans for airport structures. "Airport Terminal Buildings" sells for 55 cents, and "Administration Buildings for General Aviation Airports" for 25 cents. Orders should be sent to the Superintendent of Documents, GPO, Washington 25, D. C.

Air pollution . . . . The fourth volume in a continuing survey of Russian literature on air pollution and related occupational diseases, being conducted by Dr. Ben S. Levine under a U. S. Public Health Service research grant, is now available from the Office of Technical Services, U. S. Department of Commerce (Washington 25, D. C.). This latest volume, translated by Dr. Levine, reports the use of sanitary clearance zones to abate air pollution in industrial areas. The price is $4.00.

Flood control . . . . Reports of major studies carried out by the Bureau of Flood Control and Water Resources Development of the United Nations Economic Commission for Asia and the Far East are being published as the UN Flood Control Series. A recently released publication, fifteenth in the series, contains the transactions of the Interregional Seminar on Hydrologic Networks and Methods, held in Bangkok, Thailand, in July 1959, under joint sponsorship of ECAFE and the World Meteorological Organizaton. Flood Control Series No. 15 may be ordered from the Sales and Circulation Section, United Nations, New York, N. Y.

Land use . . . . Availability of a brochure, entitled "Land Use and Municipal Finance," is announced by the University of Connecticut. Copies of the publication—prepared for the West Hartford (Conn.) Department of Planning by S. Charles Adams, A.M. ASCE, of the civil engineering faculty—are available at $1.00 each from the Town Plan and Zoning Commission, Town Hall, West Hartford, Conn.

Beach erosion . . . . Beach erosion, coastal damage, and the problem of maintaining navigable waterways are areas of recent study reported in several new Technical Memoranda of the Beach Erosion Board. Technical Memorandum No. 119 is entitled "Sand Movement by Wind Action"; No. 120, "The Prediction of Hurricane-Storm Tides in New York Bay"; and No. 121, "Development and Tests of a Radioactive Sediment Density Probe." Inquiries should be addressed to the Beach Erosion Board, Office of the Chief of Engineers, Washington, D. C.

Building research . . . . The role of plastics and adhesives in modern construction has been studied in two recent programs sponsored by the Building Research Institute of the National Academy of Sciences-National Research Council. "Adhesives in Building," identified as Publication 830 and selling for $5.00, gives data for lamination of structural timber beams; bonding of cementitious materials; and bonding of gypsum drywall construction. "Information Requirements for Selection of Plastics for Use in Building" is identified as Publication 833 and priced at $3.00. Orders should be sent to the Building Research Institute, 2101 Constitution Avenue, N. W., Washington 25, D. C.

Pollution control . . . . The current status of pollution abatement in the Interstate Sanitation District (New York, New Jersey, and Connecticut) is discussed in the 1960 report of the Interstate Sanitation Commission. During the year about 42 abatement projects were advanced in the District through the combined efforts of municipal, state, and interstate agencies. Inquiries about the 1960 report should be addressed to the Interstate Sanitation Commission, 10 Columbus Circle, New York 19, N. Y.

Cement and concrete . . . . Availability of a "Comprehensive Bibliography of Cement and Concrete, 1925-1947" is announced by Purdue University. The 23-year coverage includes over 40,000 references from all over the world. The price is $3.00. Checks should be made out to Purdue University, and orders addressed to Joint Highway Research Project, Purdue University, Lafayette, Ind.

Research . . . . The impact of scientific and technological progress on society is being examined in more than 200 research projects in U. S. colleges and universities and in other non-profit institutions. These studies are described in a recent National Science Foundation publication, entitled "Current Projects on the Economic and Social Implications of Scientific Research and Development, 1960." Copies are for sale by the Superintendent of Documents, GPO, Washington 25, D. C., for 40 cents.

Sewage treatment . . . . An evaluation of extended-aeration sewage treatment plants now in service in the United States has been prepared at the U. S. Public Health Service's Robert A. Taft Sanitary Engineering Center. The survey revealed a marked increase in use of small plants of this type. (Extended-aeration sewage treatment is a modification of the activated sludge process that provides for aerobic sludge digestion within the system.) Free copies of the study, identified as Technical Report W60-6, may be obtained from the Director, Robert A. Taft Sanitary Engineering Center, 4676 Columbia Parkway, Cincinnati 26, Ohio.

Atomic energy . . . . U. S. policies and programs relating to the peaceful uses of atomic energy have been reviewed in five voluminous reports to the Congressional Joint Committee on Atomic Energy. Material on the status and prospects for atomic science and technology has been reviewed, evaluated, and summarized by experts under contract to the Atomic Energy Commission. For comparative background, more than 200 interviews were conducted in fourteen European countries, including the Soviet Union and Poland. Robert McKinney is the author. Inquiries about the series, entitled "Background Material for the Review of the International Atomic Policies and Programs of the United States," should be addressed to the Superintendent of Documents, GPO, Washington 25, D. C.

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Philadelphia, Pennsylvania
Contractor:
John T. Donovan, Builder,
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This beautiful library building of the Gwynedd Mercy Junior College near Philadelphia won the 1959-60 Design Award presented by the A.I.A. Local Chapter, Pennsylvania Society of Architects.

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RECENT BOOKS

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Advanced Design in Structural Steel
Design rather than analysis is emphasized, frequent reference however being made to other sources for methods of advanced analysis, and for derivation of equations. Work methods of analysis are favoured over the Cross methods and the method of slope deflection. The appendixes include much useful information such as lists of frequently used formulas and equations. The book is intended as both an advanced text and a reference for practicing professionals. (By John E. Lothers. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1960. 583 pp., bound. $15.00.)

Air Pollution
One of the Monograph Series of the World Health Organization, this work reflects world trends in air pollution research. Participating in the project as contributors or editors were experts from the U.S., England, Belgium, Italy, India and South Africa. Following a general introduction, the fourteen individual papers discuss aspects of air pollution such as historical development, identification of the a-p problem, the role of meteorology in a-p, sampling, analysis and instrumentation, effects of a-p on human health, animals, and plants, its physical and chemical nature, economic and social aspects, including specific legislation and enforcement, control by site selection, zoning, and process changes or equipment, fuel selection and utilization, and radioactive pollution. (Published on behalf of the World Health Organization by the Columbia University Press, 2960 Broadway, New York 27, N. Y., 1961. 442 pp., bound. $10.00.)

Coastal Changes
The author states that this is not a "treatise on the new methods" of coastal investigations but a brief statement of the current state of the art and "an opinion of the direction that future investigations should take". First, the implications of coastal material are considered, especially their reactions to the more important processes to which they are subjected, such as wave behavior, and currents. Next, the processes themselves are discussed, and following this is a brief examination of how far existing forms can be explained in terms of these two factors. The final chapter deals with defenses against the attack of the sea in coastal regions. The brevity of the book is due to extensive simplification of material included (which frequently becomes clarification), and by omission of material which actually is based on guesswork, for "there is still much that is not understood". (By W. W. Williams. Routledge and Kegan Paul Ltd., London, England, 1960. 220 pp., bound. 28s.)

Library Services

Engineering Societies Library books, except bibliographies, handbooks, and other reference publications, may be borrowed by mail by ASCE members for a small handling charge. The library also prepares bibliographies, maintains search and translation services, and can supply a photoprint or a microfilm copy of any items in its collection. Address inquiries to R. H. Phelps, Director, Engineering Societies Library, 29 West 39th Street, New York 18, N. Y.

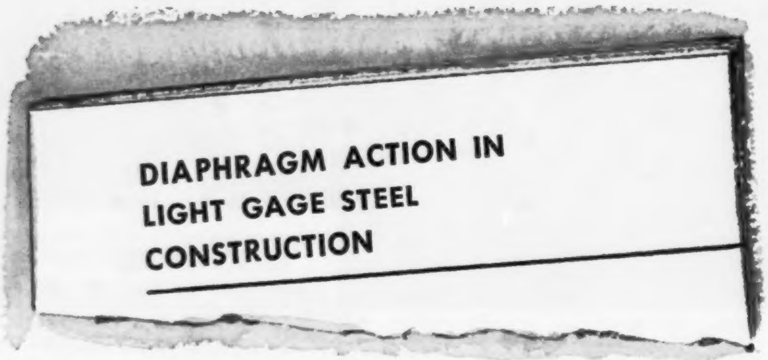
Design of Concrete Pavements for Airports
This volume presents, with only limited discussion, the experience-tested design criteria and practices developed and adapted by airport agencies for the construction of reinforced concrete pavements. The book is a manual, intended to provide the design engineer with essential data, drawings and tables which will facilitate the preparation of detailed sets of construction plans. It is based on the strength and dimensional standards of both the Federal Aviation Agency and the International Civil Aviation Organization, and is thus especially applicable to civil airports, although the principles and procedures described apply also to military airports. (Published by the Wire Reinforcement Institute, National Press Building, Washington 4, D.C., 1960. 96 pp., bound. $3.00.)

E.I.T. Review
The objective of this book is to reiterate basic engineering principles and ideas and to direct the reader to pertinent information in other publications, as preparation for state registration examinations for engineer-in-training or a professional engineering license. The material is very briefly stated, covering only the most fundamental principles in each section. Each chapter includes a list of selected references and illustrative problems with answers. The final chapter contains sets of questions relevant to specific fields of professional practice. (By Virgil M. Faires and Joy O. Richardson. Prentice-Hall, Inc., Englewood Cliffs, N. J., 1961. 256 pp., bound. $9.00.)

Electronic Surveying and Mapping
The author has collected, listed, and analyzed available material on the application of electronics to surveying and mapping, and has included his own experiences as researcher and teacher, first at the Finland Institute of Technology, and later at Ohio State University. He has arranged the book so that it will be usable by geologists unfamiliar with electronics, and by electrical engineers unfamiliar with geodesy.

(Continued on page 118)

Now available from Fenestra, this important research report



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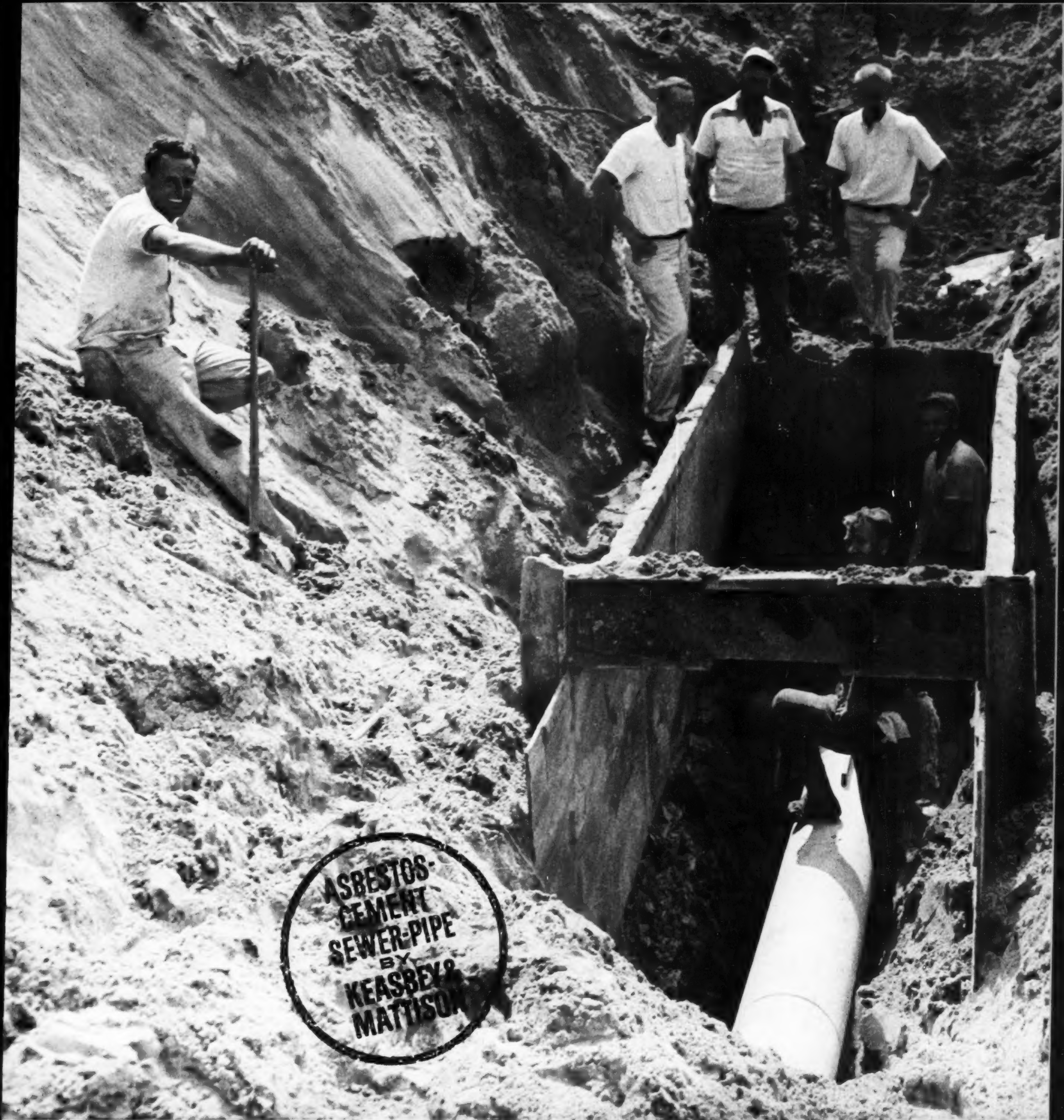
Please send me the report on Diaphragm Action in Light Gage Steel Construction.

Name__________

Address__________

City______ Zone______ State______

Company______ Position______



P. H. Van Orden, President, C. L. Peterson, Vice-President and Treasurer, and R. H. Webb, Foreman of the Van Orden Company, Contractors, of Grand Rapids, Mich., supervise the installation of "K&M"® Asbestos-Cement Sewer Pipe at Paw Paw, Mich.

10,000 FT. OF SEWER PIPE LAID...

...not enough infiltration to measure

Read how the Van Orden Company solved the problems of installation and of infiltration when pipe had to be laid 9 ft. below the water table.

P. H. Van Orden

“the ease of handling and assembly saved us dollars and time!”

"Construction of the Paw Paw trunk sanitary sewer called for installation of pipe at depths up to 19 feet, where water table was at 10 feet. Infiltration had been the major problem in other sewer installations in the area. We solved this problem by using "K&M" Asbestos-Cement Sewer Pipe with its FLUID-TITE joint. With 10,000 feet of sewer in, we haven't had enough infiltration to measure.

"The longer laying lengths and the speed with which a joint can be made are definite time-saving factors, which have added to our production. Less time spent grading pipe and handling material means dollars saved."

Rigorous tests prove "K&M" Asbestos-Cement Sewer Pipe is infiltration-tight at 25 psi . . . a pressure equivalent to that of a 58-foot head of water.

"K&M" Asbestos-Cement Sewer Pipe wont rust, rot, or corrode. Its smooth bore remains clean, permanently. Flatter grades are possible. Fewer lift stations are required.

Maintenance-wise, the village of Paw Paw, Mich., will enjoy tax savings. "K&M" Asbestos-Cement Sewer Pipe is practically indestructible. Requires fewer inspections, because root growths do not penetrate the exclusive FLUID-TITE coupling.

Write today for more information on "K&M" Asbestos-Cement Sewer Pipe to: Keasbey & Mattison Company, Ambler, Pa.

Keasbey & Mattison at Ambler

K·M BEST IN ASBESTOS

Two-step assembly! Lubricate the tapered end of "K & M" Asbestos-Cement Sewer Pipe, then slide it into the exclusive, patented "K&M" FLUID-TITE® Coupling.

Light weight reduces shipping and handling costs...saves on installation time. At the same time, there's a minimum of wastage and breakage on the job, with tough "K&M" Asbestos Sewer Pipe.

Finish on time, skip the overtime ...with STEEL

When it's important to get a job done in a hurry, use steel. Fed-Mart, Inc., Houston, Texas, knew they had to open their retail merchandising center by November 26, 1960 in time for the pre-Christmas shopping season.

To save time, structural steel was chosen by the owners and also the general contractor, Jaffe & Martin Builders, Inc., San Antonio. So in just 80 working days the 116,000 sq. ft. building was ready for opening—on schedule.

Here's what the owners say that meant to them:

Several million dollars of Christmas sales
gained because the store opened on time.

$50,000 savings in overtime
provided for but not required.

STEEL pays off—
—even with demanding construction schedules.

American Institute of Steel Construction
101 Park Avenue, New York 17, N.Y.

HERE IS **DEEP STRENGTH** DESIGN ON OHIO INTERSTATE 71

A. 1½-inch Asphalt concrete surface course

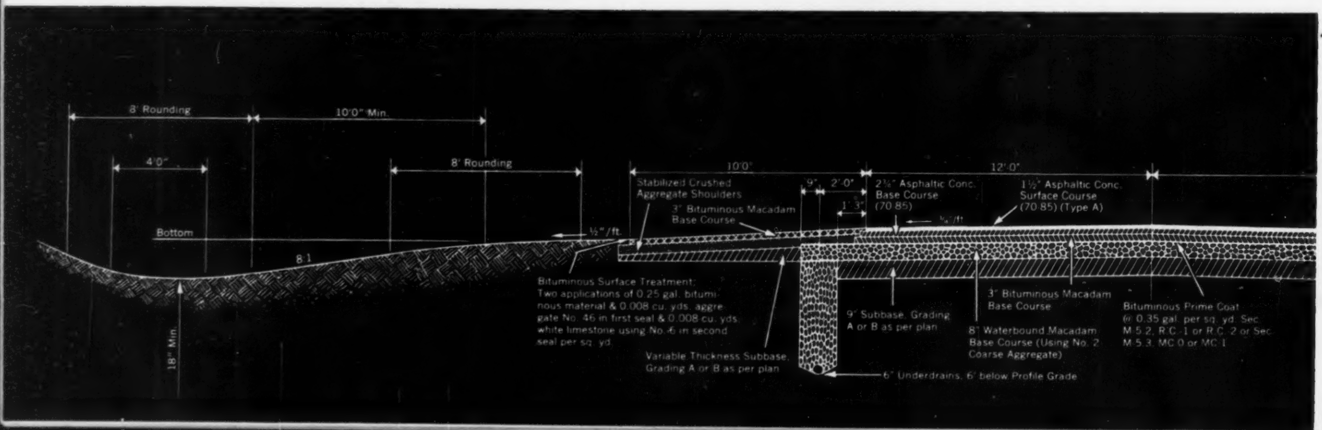
B. 2¾-inch Asphalt concrete base course

C. 3-inch penetration Asphalt macadam base course

D. 2—4-inch water-bound macadam base courses

E. 9-inch selected gravel subbase

For strength and durability. 7¼ inches of Asphalt surface and base are laid on 17 inches of compacted aggregate.



New DEEP STRENGTH Asphalt section extends northeast paralleling existing U. S. Route No. 42.

New Section of Interstate 71:

First DEEP STRENGTH Asphalt Paved Interstate Highway in Ohio!

Traffic is now rolling on the first DEEP STRENGTH Asphalt paved Interstate Highway in Ohio. Serving a highly industrialized area, this new 17-mile section of Interstate 71 will be subjected to heavy freight traffic.

That's one reason why Ohio State highway engineers chose DEEP STRENGTH Asphalt pavement. Notice in the cross-section drawing (below) how design follows precepts of DEEP STRENGTH Asphalt construction . . . heavy-duty Asphalt concrete surface course . . . heavy-duty Asphalt base . . . Asphalt primed subbase . . . **depressed median and deep longitudinal drain on outside and inside shoulders for good drainage** . . . heavy proof-rolling of subbase . . . and use of high-contact pressure pneumatic proof-roller on all other courses. HERE IS STRENGTH AND DURABILITY!

When built like this—for DEEP STRENGTH—Asphalt pavements will carry heaviest traffic loads without distress . . . and with minimum maintenance cost.

And, most important, Asphalt pavements built to this Advanced Design Criteria can often save money over the cost of Asphalt pavement designed to other standards. That's because the Advanced Design Criteria permit inexpensive Asphalt base to be substituted, within limits, for more expensive Asphalt concrete surfacing, and allow reduction in total structure thickness when used in place of untreated base.

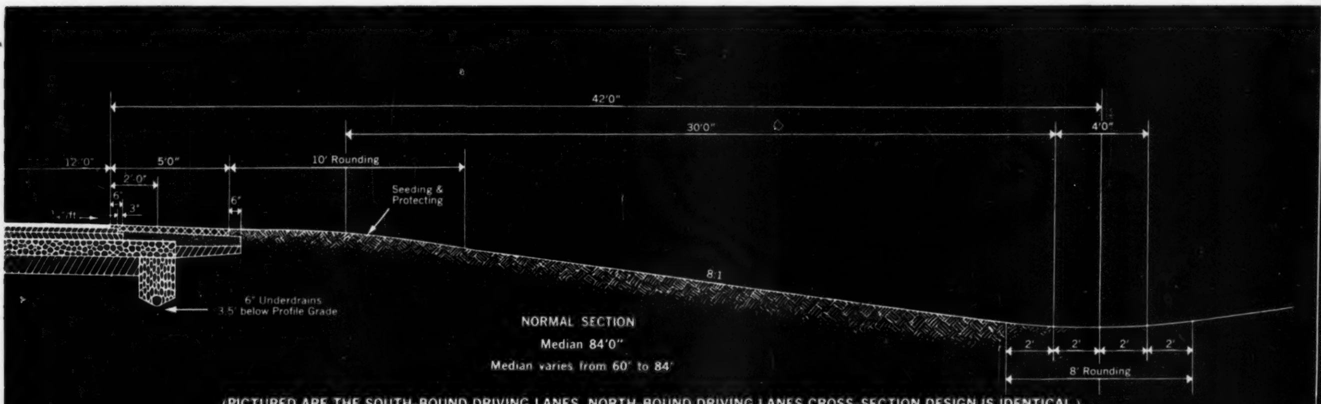
NEW HANDBOOK! A new edition of the *Asphalt Handbook* incorporating all the Advanced Design Criteria implied by the term DEEP STRENGTH Asphalt pavement is now available. Write to The Asphalt Institute.

For smoother riding, the subbase was proof-rolled with a 50-ton compactor using tire pressures of 150 psi. A 30-ton rubber-tire compactor with tire pressures of 120 psi was used on all other courses.

For good drainage, section was designed with a depressed median and a system of deep longitudinal drains on each side of travel lanes to prevent water from entering the foundation courses.

THE ASPHALT INSTITUTE

Asphalt Institute Building, College Park, Maryland



(PICTURED ARE THE SOUTH-BOUND DRIVING LANES. NORTH-BOUND DRIVING LANES CROSS-SECTION DESIGN IS IDENTICAL.)

NOW...*one man can splice Rubber Waterstop in just SIX minutes!*

To splice Gates new Kwik-Seal Rubber Waterstop in the field, all you need is a small splicing kit and a simple clamping device. This eliminates the need for a field vulcanizer, molded parts, a power supply or heat.

One man makes this strong, permanent splice in just 6 minutes—5 times faster than with former methods!

The Gates Kwik-Seal splice is a chemical bond. The strength of the bond often exceeds the strength even of the rubber—far stronger than government requirements. The waterstop can be handled and placed into concrete forms immediately after splicing.

As a result, this new Gates splicing method cuts labor costs and speeds the job.

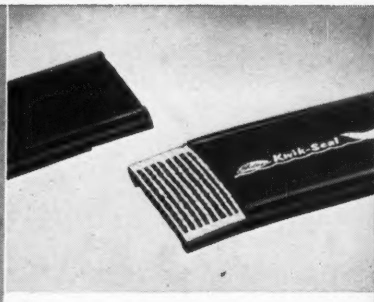
Write for CATALOG and free splicing demonstration.

The Gates Rubber Co. Sales Division, Inc. Denver 17, Colorado

Gates Rubber of Canada Ltd. • Brantford, Ontario

BP-31 *Building the Future on 50 Years of Progress* Gates

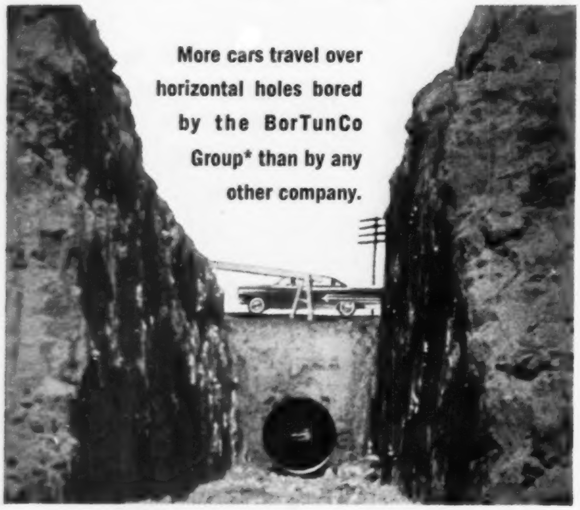
Gates *Kwik-Seal* Waterstop



1 Apply Kwik-Kem bonding chemical to prepared surface.

2 Clamp Waterstop firmly for 5 to 6 minutes . . . *and it's spliced.*

SEE OUR CATALOG IN SWEET'S



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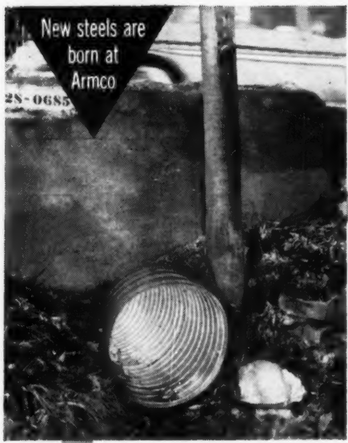
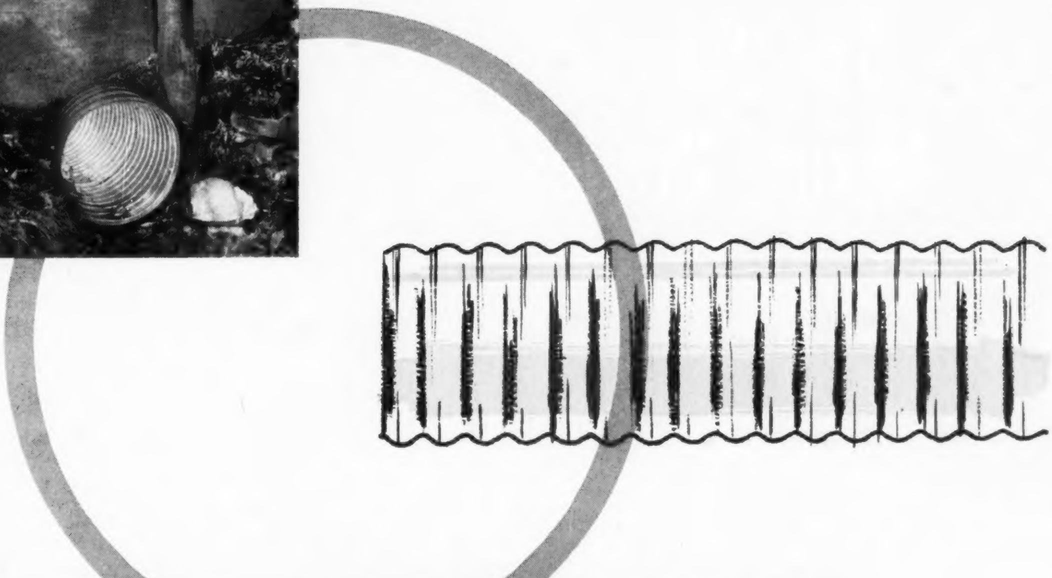


Armco Pipe, installed in 1909.



Armco Corrugated Metal Culverts OUTLAST THE ROAD!

Armco Pipe, installed in 1911.

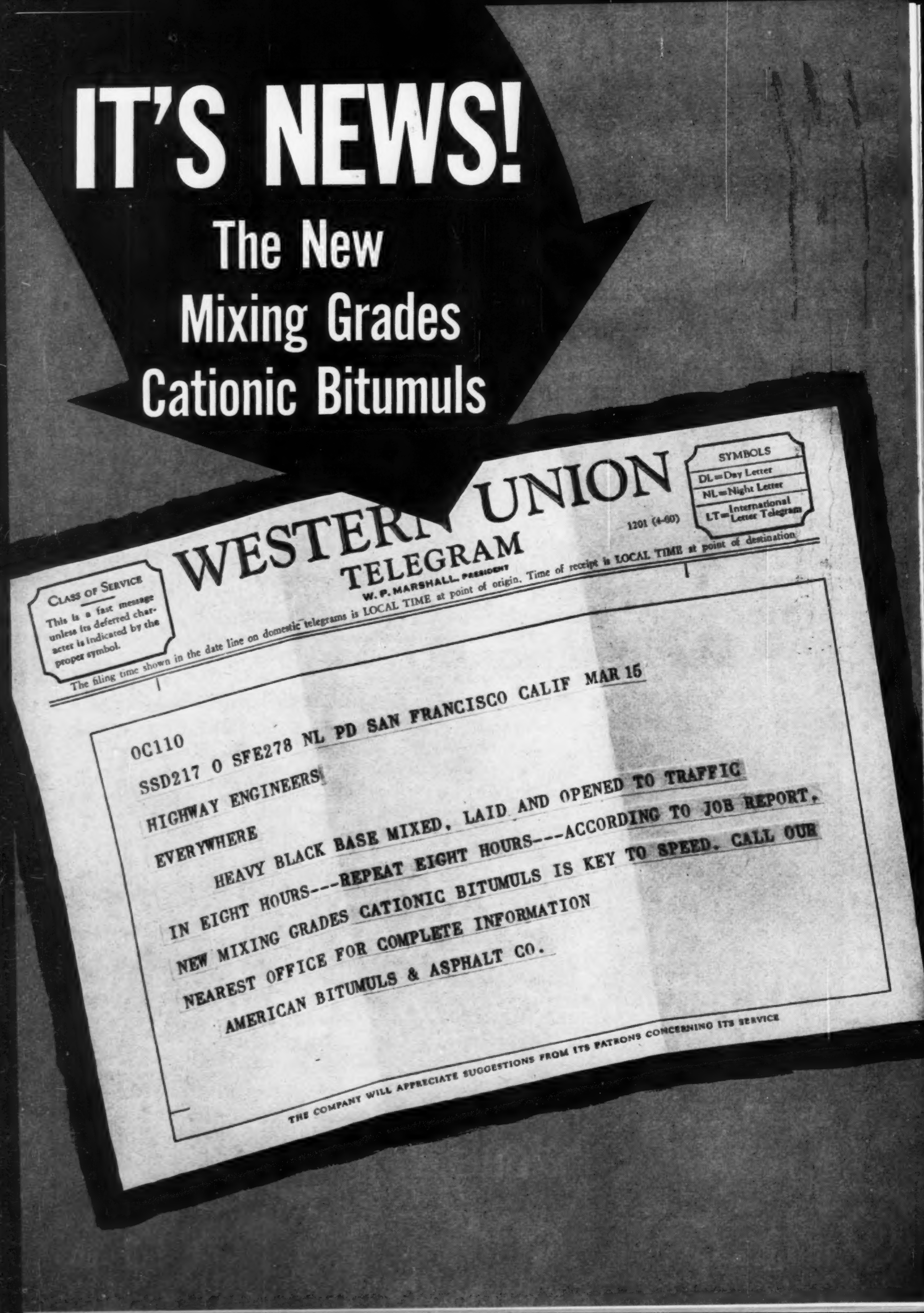
Installed 50 and 52 years ago respectively, these Armco Corrugated Metal Pipe culverts are still in good shape although the old road has been abandoned in favor of a new, wider and safer highway.

Steel for strength, economy, durability

If desired, these drainage structures in Butler County, Ohio, can be excavated and re-installed elsewhere with assurance of many more years of service.

Many engineers have long recognized the advantages of the flexible strength of Armco Corrugated Metal Structures, their durability under rigorous conditions, and the wide selection of sizes between 8-inch and 24-foot diameters. Contractors like the economy, ease of handling and installation of Armco Pipe and the helpful service of their Armco Sales Engineer. For more data, write: Armco Drainage & Metal Products, Inc., 5221 Curtis Street, Middletown, Ohio.

ARMCO Drainage & Metal Products


IT'S NEWS!
The New
Mixing Grades
Cationic Bitumuls
WESTERN UNION
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W. P. MARSHALL, PRESIDENT
1201 (4-60)
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NL=Night Letter
LT=International Letter Telegram
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This is a fast message unless its deferred character is indicated by the proper symbol.
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EVERYWHERE
HEAVY BLACK BASE MIXED, LAID AND OPENED TO TRAFFIC
IN EIGHT HOURS---REPEAT EIGHT HOURS---ACCORDING TO JOB REPORT.
NEW MIXING GRADES CATIONIC BITUMULS IS KEY TO SPEED. CALL OUR
NEAREST OFFICE FOR COMPLETE INFORMATION
AMERICAN BITUMULS & ASPHALT CO.
THE COMPANY WILL APPRECIATE SUGGESTIONS FROM ITS PATRONS CONCERNING ITS SERVICE

Daily Construction Journal

NEW MIXING GRADES CATIONIC BITUMULS CUTS HOURS FROM ROAD BASE JOBS

Nationwide Reports Stress Speed of Construction

Base mix cures fast, permits rapid compaction after blading.

Contractor Terms It "Instant Paving"

SAN FRANCISCO, CALIF.—Job reports on base construction using the new Mixing Grades Cationic Bitumuls have now been received here at company headquarters from jobs nationwide.

Initial reaction among engineers and contractors connected with these jobs has been surprisingly uniform: all are impressed with the speed and ease of base construction using this new material. One contractor is reported to have used the term "Instant Paving" when referring to the base mix prepared with the new Mixing Grades Cationic Bitumuls.

This new product, developed by American Bitumuls & Asphalt Company, readily coats a wide range of aggregates—including many that are normallly considered "difficult". The mix is prepared in simple, high-capacity equipment, and can be spread and compacted immediately. There is no delay for aeration.

"BETTER ROADS, FASTER"

Company engineers sum up the advantages of Mixing Grades Cationic Bitumuls in these few words: "Gives you better roads, faster." Every job report to date bears out this brief statement. Such terms as "better adhesion in the presence of water"; "improved early cohesion of the compacted mixes"; "better mixing properties due to fluidity", are frequently used in these reports as reasons for faster, better road construction.

Company Offers Data On New Mixing Grades Cationic Bitumuls

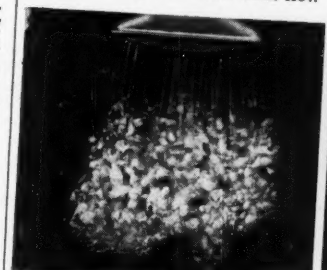
American Bitumuls & Asphalt Co. will welcome inquiries regarding the new Mixing Grades Cationic Bitumuls. Information on this new material is available from the locations shown, right.

Drag Strip Built in Five Working Days

PANAMA CITY, FLA.—The rapid mixing and placement of a sand mix base, stabilized with new Mixing Grades Cationic Bitumuls, was credited with speedy construction of an automotive drag strip near here recently.

The installation, a private project, was started on Wednesday. Preliminary clearing and grading were followed immediately with the mixing operation. Using a travel mixer, windrows of native sand were treated with new Mixing Grade Cationic Bitumuls; the mix was spread, compacted and opened to construction traffic immediately. On Friday, just two days later, this base was given a conventional sand seal and the strip was ready for operation.

Contractors on the job were reported as "impressed" with the ease and speed of the operation; and with the fact that occasional showers during the base mixing operation had no visible effect on the quality of the mix.



Laboratory Wash-Tests Prove Early Set Of New Mixing Grades Cationic Bitumuls

These two photos taken in the laboratory of American Bitumuls & Asphalt Co., demonstrate the "holding power" of the new Mixing Grades Cationic Bitumuls.

In the above photos you see the results of this test: the stone coated with the anionic binder is on the left; that coated with the Cationic binder on the right. Note the complete coverage maintained by the Mixing Grade Cationic Bitumuls.

Cuts Traffic Tie-Up With Quick-Set Mix

EUGENE, ORE.—On a short heavily-traveled section of a major highway outside of Eugene Oregon, engineers specified construction of a four-lane divided pavement with a minimum of traffic tie-up. They authorized the contractor, Wildish Construction Company, to use the new Mixing Grades Cationic Bitumuls for quick-setting Black Base construction that could be opened to traffic before it was surfaced.

Using a good quality graded aggregate (100% passing ¾"; 5% passing #200 mesh) the contractor prepared the base mix in a central plant using a simple pug mill. Rate of mix production (about 400 tons/hr.) was limited by assigned trucking capacity.

Pug mix direct to truck

The cold-prepared mix was trucked to the job in a fleet of bottom-dumps; bladed to grade; then compacted. It was opened to traffic the following morning while work was continued on the lanes across the dividing strip.

In reporting on the job, the Project Engineer stressed the good workability of the Cationic mix, plus the speed and ease of lay-down.

Cationic Bitumuls Stockpile Mix

Development of the new Mixing Grades Cationic Bitumuls has made possible, in some areas, the production of a patching and maintenance mix that can be prepared in advance; stockpiled until needed. The new Stockpile Mix retains good workability yet sets up readily after placement and compaction under traffic. This mix uses selected graded aggregates. Details are available from Company headquarters.

American Bitumuls & Asphalt Company

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no wonder the contract went to steel—steel cut costs by $23,000!

They were almost ready to go ahead on the new bridge in Elkhart County, Indiana, when they decided to take a second look at costs. Original plans called for material other than steel, but maybe steel construction could save money.

And save, it did! Steel bids were actually $23,000 lower and that wasn't all. Maintenance had not been one of the considerations till the steel bid suggested its importance—as one consulting engineer put it, "I've never seen or heard of any type bridge which is maintenance-free." Thus, even with maintenance included, steel construction was shown to be less costly than any other material. In fact, accompanying studies clearly showed the only maintenance required would be painting and that only $4,488.84 invested at 3% would take care of that for 50 years. Thoroughly convinced, the County Commissioners changed the plans and awarded the contract to steel.

Use Steel for Modern Construction

This is another example of the efficiency, lower initial cost and minimal maintenance required when construction plans call for STEEL!

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because it can be used to support loads economically on spans of any desired length, and because the lightness of steel in proportion to its strength makes it the least costly to transport and to handle on the job site.

STRONGER AND LIGHTER

because dead load stresses are minimized. Steel decking may take the form of flat steel plates, corrugated steel planks or gridwork either open or filled.

MODERN

because steel can be fabricated into forms of the utmost lightness and grace as well as into massive and majestic structures. What's more, steel can be coated with color in infinite variety to blend or contrast with the surrounding landscape—thus form and color are combined by the designer to attain modern beauty and perfection.

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If you are interested in any of these listings, and are not registered, you may apply by letter or resume and mail to the office nearest your place of residence, with the understanding that should you secure a position as a result of these listings you will pay the regular placement fee. Upon receipt of your application a copy of our placement fee agreement, which you agree to sign and return immediately, will be mailed to you by our office. In sending applications be sure to list the key and job number.

When making application for a position include eight cents in stamps for forwarding application.

Men Available

PROJECT ENGINEER, M. ASCE, M.S., registered P.E., 42. Over twelve years of diversified experience in planning, design and construction supervision of highways, dams, buildings, etc., reports and specifications. Very specialized experience in soils, foundations and materials. Desires responsible position preferably with consulting engineers. Available this spring. Will relocate anywhere. Salary, $10,000 to $15,000, depending on job and location. C-674.

CIVIL ENGINEER, M. ASCE., B.S.C.E., registered civil engineer and land surveyor in Florida; 38. For ten years designed roads, drainage, water and sewer works as well as structural edifices. Experience on construction projects include surveying, inspection, investigation and reports. Salary, $10,400-Domestic; $13,000-Foreign. C-675.

SUPERINTENDENT ENGINEER, M. ASCE, B.S.C.E. Fourteen years of experience supervising, field work, planning, coordinating and costing on all types of construction, power plants missile sites. Six years in Africa. Speaks fluent Spanish. Will relocate anywhere. C-673.

CONSTRUCTION MANAGER/ENGINEERING MANAGER, M. ASCE., B.S.C.E. Experience in all phases of business management and administration. Significant achievement in maintenance and repair, welded design, and design and construction of transportation and bulk handling facilities. Conscious of economic values. C-677.

SANITARY ENGINEER, CONTRACT ADMINISTRATOR, A.M. ASCE, B.S.C.E., M.C.E. Twelve years of experience in reports, design and supervision of construction on sanitary engineering projects. Interested in responsible position with opportunity for advancement. Salary, $12,000 minimum. Prefer Northeast. C-678.

ENGINEERING ADMINISTRATOR, F. ASCE, B.S.C.E., M.S.C.E., ASTM's High Research Board, 56. On the basis of 23 years of experience in all phases and levels of responsibility—construction manager, project engineer, municipal works, Rand D director, civil engineering professor—seeks responsible affiliation with construction or consulting firm, or college staff position (preferably with consulting opportunities). Interested in profit or ownership-sharing arrangements; relish reasonable travel. Prefer South or Southwest. C-679.

SANITARY ENGINEER, ASSISTANT PROFESSOR, A.M. ASCE, B.C.E., M.S.C.E., Doctoral Candidate, P.E. in N.Y. Would teach water and waste treatment, sanitary chemistry including nuclear aspects, and topics in water resources. Research experience in radio-active waste disposal. Available Sept. 1961. C-680.

STRUCTURAL DESIGNER, OFFICE ENGINEER, A.M. ASCE, B.S. in Civil, 35. Ten years in field and office, following the design and construction of industrial type buildings. Salary, $9,000 a year. Prefer Chicago area. C-2132-Chicago.

CONSTRUCTION SUPERVISOR AND/OR ADMINISTRATOR, A.M. ASCE, B.S.C.E. and M.B.A., 29. Three years of combined experience on bridge and road construction, sewers and water mains for concrete specialists. Would desire position with land development and/or residential or commercial construction. Salary, $8,400 a year. Will relocate anywhere in U.S. C-2136-Chicago.

PROJECT MANAGER, RESIDENT ENGINEER, FIELD ENGINEER, M. ASCE, B.S.C.E., 40. Thirteen years of complete and extensive background in concrete and steel building construction, from estimates and bidding to job completion, industrial and commercial. Prefer assignment of responsibility and trust. Salary, $12,000 a year. C-2137-Chicago.

SALES ENGINEER, M. ASCE, CE, 38. Sales experience in filters, related, equipment service, some experience in fluid mechanics, strength of materials, structures. Prefer East, West U.S. or Foreign. Salary $9,000 a year. Se-1426.

PROJECT MANAGER, RESIDENT ENGINEER, M. ASCE, CE, 25. Twenty-five years of experience in construction, management in planning, design, maintenance and operation including box culverts, retaining walls, pumping stations, underpass, structures. steel bridges, determine sources of stream pollution. Will relocate anywhere. Salary, $10,000 a year. Se-1359.

FIELD ENGINEER, A.M. ASCE, CE, 32. Seven years of experience in field inspection and testing on major process units, vessel and piping codes, as maintenance engineer of process units, power house, estimating, road, bridge, building construction and maintenance, some quarry and demolition work. Some experience in framing and finishing carpentry on small homes. Prefer West U.S. or Foreign. Salary, $9,000 a year. Se-1310.

STRUCTURAL ENGINEER, M. ASCE, CE, 32. Two years of experience in subdivision development designs and construction of large oil camps, planning and scheduling men and equipment for maintenance and construction for refinery. Experience in inspection and supervision of all structural steel erected for paper mill. Prefer West U.S. or Foreign. Salary, $8,500 a year. Se-1294.

Positions Available

STRUCTURAL ENGINEER, at least an M.S. degree from recognized engineering school. Good future for young and responsible engineer who is well grounded in the theory of elasticity to handle complex indeterminate structures. Submit graduate school credits. North Carolina. W-235.

STRUCTURAL DESIGNER, civil graduate, with experience on reinforced concrete buildings including foundations. Salary, $9,620 a year. New York City. W-218.

EASTERN FIELD EDITOR with civil engineering training and construction experience, to visit construction jobs and write articles covering job operations. Must have car. Considerable traveling, Maine to Florida. Resident of New York area preferred. Salary, $7,500-$9,000 a year. W-215.

RESIDENT ENGINEERS, owner's representative, with experience on large apartment housing construction in New York City. 1,000-unit jobs. Salary, $9,000 a year. W-205.

CIVIL ENGINEERS (*a*) Project engineer, graduate civil, with a minimum of 10 years of experience in highways and airports. Some supervisory background desired. Must be qualified to assume responsibility of project for production of complete plans, specifications, estimates, etc. Salary $6,700-$8,500 a year. (*b*) Senior designer, civil, with background in highways and airports. Experience in design of storm water drainage systems, rigid and flexible types of pavement, highway and interchanges, cost estimates, etc. Maryland. W-202.

CIVIL ENGINEER, with 5 to 10 years of experience in the design of water and sewer projects. Salary $7,800-$9,000 a year. Upstate N.Y. W-201.

ASSISTANT PROJECT SUPERINTENDENTS. (*a*) Graduate civil for construction of 300 MW thermal power plant including coal handling and circulating water systems and all field personnel facilities. Two-year duration. (*b*) Civil graduate for construction of 130 MW power station including 2 turbine-generators each 65 MW and complete circulating water system. Two-year duration. (c) Graduate civil for construction of 300 NW thermal power station consisting of 4 turbine-generators each 75 MW with coal handling and circulating water systems. Thirty-month duration. Far East. F-198.

PROJECT SUPERINTENDENTS. (*a*) One to take charge of construction of 300 MW thermal power plant including coal handling and circulating water systems and all field personnel facilities for three years. (*b*) The second to take complete charge of construction of 15 MW thermal power stations including 2 turbine-generators, each 7-5 MW with coal handling and circulating water system for two years. Far East. F-197.

ESTIMSTOR, degree, on building construction with established general contractor in private work. Experience in N.Y.C. area on takeoff, pricing, sub-contractor relations. Professional license desirable. Salary to $10,000 a year. N.Y.C. W-190.

TEACHING POSITION, sanitary engineering; Ph.D. in sanitary or civil engineering, with an interest in both teaching and research. Salary and rank open depending upon qualifications. East. W-189.

STRUCTURAL DESIGNER, civil graduate, preferably with P.E. license and at least 5 years of design experience in reinforced concrete buildings and fabricated steel construction for architect-engineer firm. Salary open. Western Massachusetts. W-179.

DESIGNER, civil graduate, with at least 10 years of experience on wide area storm drainage. Local highway drainage not acceptable. Salary about $9,100 a year. Central New Jersey. W-177.

HYDRAULIC ENGINEER, graduate, with 5 to 10 years of experience on layout and design of irrigation systems and structures. Permanent position with engineering firm doing extensive irrigation work in foreign countries. Submit complete resume. Salary, $10,000-$12,000 a year. New York City. W-170.

STRUCTURAL ENGINEER, with experience in the design and supervision of industrial building alterations and installation of equipment (food processing). Experience in material or bulk handling equipment desirable. Salary, $10,000-$12,000 a year. Midwest. W-160(*b*).

INSTRUCTOR for department of civil engineering, structural mechanics, Ph.D. in civil engineering or mechanics. Area of specialization in mechanics not critical; could be plasticity, stability, dynamics or some other topic. Rank and salary open. East Coast. W-150.

VILLAGE ENGINEER, N.Y. State P.E. license, with 10 years of experience in highway department operations, building code enforcement, city planning. Organizational and administrative ability desirable. Population 15,000. Salary to $11,000 a year. Suburban Long Island, N.Y. W-127.

STRUCTURAL DESIGNER, graduate, with experience in the structural design of steel buildings. Any building architectural work helpful. Salary, $10,400 a year. New York City. W-120.

PLANT OPERATIONS ENGINEER, graduate civil, to 40; must have practical experience in all phases of concrete engineering such as materials, redimix plant operations, quality control, etc. Good opportunity with progressive company. Salary, to $9,600 a year depending on expreience. Employer will pay placement fee. Chicago area. C-8588.

FIELD ENGINEER, civil engineer, with at least three years of experience in heavy construction work on either construction or on prestressed concrete. Good knowledge of building construction. Duties include working in prestressed concrete plant, handling methods and production problems, setting up beds, calculating stress of materials, maintaining tolerances; also handle shipping problems. Salary, $9,000 a year. Employer will pay placement fee. Chicago. C-8558(*a*).

CIVIL ENGINEER, graduate preferred, to 45, with experience in quality control and concrete technology to assist principal quality control engineer in control of concrete and general quality of precast beams, slabs, etc. for three plants located in Ohio and Michigan. Business concrete products. Salary, $7,200-$9,000 a year. Ohio. C-8474.

This is only a sampling of the jobs available through the ESPS. A weekly bulletin of engineering positions open is available at a subscription rate of $4.50 per quarter or $14 per annum, payable in advance.

CIVIL ENGINEER, UTILITIES ENGINEER, age 25 to 50. Degree and registration required. Professional civil engineering work in design, location installation and construction of public works or utilities projects. Work involves the application of technical engineering to performance or supervision of survey, design, maintenance and construction. Work available in public works projects and city utilities projects. Electrical experience preferred in utilities position and sanitary engineering experience preferred in public works position. Registration with 5 or more years of professional experience desired. Salary, to $8,673 a year. Michigan. C-8434.

COUNTY ENGINEER, CE, California Registration, age open with minimum of 6 years of responsible professional experience. Director of Public Works will base his decision on the senior engineer best qualified to take charge of design and construction, surveys, inspections, reports and mapping of highways, subdivisions, bridges, drainage works, sewers, and water projects. Salary, $750-$900. Valley—Sierra Area in northern California. Sj-6030.

STRUCTURAL ENGINEER, CE, California Registration, age open with a minimum of 7 years of experience in analyzing structural requirements, preparing drawings and specifications, conforming to code requirements and calculations to meet codes, on steel prefabricated buildings and structural elements. Will act as application engineer working with sales department for a manufacturer of prefab buildings and components. Salary, $700 plus. Berkeley, Calif. Sj-6025.

DESIGNER, (Licensed), CE or Arch, age open. Experience should include 3 to 4 years on schools plus commercial buildings, understanding of architectural work and ability to handle completely and independently all phases of structural work including drawings for an architectural firm. Berkeley, Calif. Sj-6015.

TAKE-OFF-ENGINEER, civil background, age open. Well qualified take-off (quantities survey) man, fast, accurate, straight quantities, no pricing. Completely qualified in general contractors type work, no subs. Knowledge of concrete, forms, excavation (hand and machine), foundations, steel, carpentry (rough, finish and millwork), miscellaneous iron. Preferably in $2,000,000 up high rise buildings. For a general contractor in San Francisco. Salary, $700-$800. Sj-6008.

SUPERINTENDENT, CE preferred, age open, will consider semi-retired man. Experience in design and operation of pipeline systems. Duties include study of water supply, design of pipeline extensions, preparation of maps and charts and supervision of small maintenance and construction crew. For California irrigation district. Salary, $600-$700. Sj-5981.

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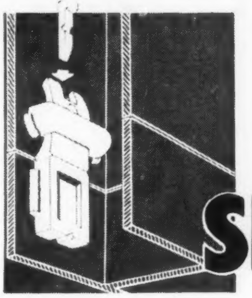
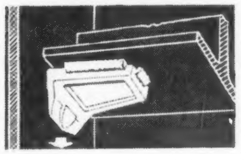
SAXE SEATS & CLIPS



C-1 Clip . . . For Steel Column or Pile. Splice.

GUARANTEE THE MOST **ECONOMICAL CONSTRUCTION**



K-3 Clip . . . Fixed Position Manual Adjustment.

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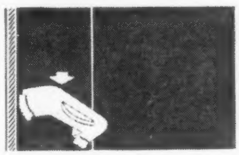

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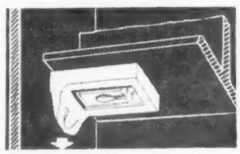

K-3A Clip . . . Automatic Adjustment, 2 Directions. Horizontally.

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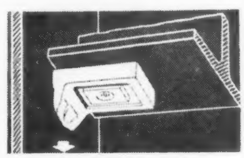

K-3B Clip . . . Automatic Adjustment, 4 Directions. Horizontally.

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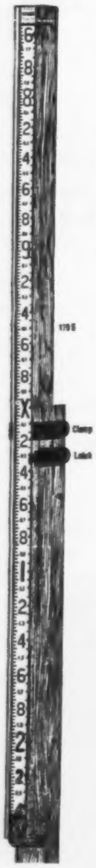
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Recent Books

(Continued from page 104)

Part 1 presents the basic principles of electricity, electronics, electronic surveying and its instruments. In Part II the electronic and magnetic features of various electronic surveying systems are analyzed, emphasizing those functions which primarily effect the accuracy of measurements. In Part III, reductions and corrections of the instrument data are derived so that information obtained from the electronic surveying instruments may be applied to the ellipsoid or the map projection plane. Written as a college text, this book will be valuable to all interested in this subject. (By Simo Laurila. The Ohio State University Press, 164 West 19th Street, Columbus 10, Ohio, 1960. 294 pp., bound. $6.00.)

Structural Concrete

This volume surveys the whole field of structural concrete, dealing with materials, design, and construction. Two of the chapters present short summaries on two topics treated at length in the author's previous books, "Prestressed Concrete" (1952), and "Precast Concrete" (1955). The first part of this present work deals with the properties, mix design, quality control, placing, compaction, curing, and other treatments of concrete. Part two deals with design, making frequent references to the Codes of Practice for reinforced concrete of the U.S., Great Britain, France, Germany, and other countries. Subjects such as shell construction and factory-made concrete products, not covered extensively in the Codes, are stressed, the author basing his treatment on current accepted practice in Great Britain and abroad and his own experiences. Part three deals with the design and construction of all kinds of concrete structures, from foundations to dams, presenting fundamental analyses of loading and operating conditions, structural analyses, design techniques and illustrative examples. (By Kurt Billig. St. Martin's Press, Inc., 175 Fifth Avenue, New York 10, N. Y., 1960. 1,020 pp., bound. $17.50.)

Wave Propagation in a Turbulent Medium

This translation and Chernov's "Wave Propagation in a Random Medium" (McGraw-Hill, 1960) furnish a comprehensive and authoritative survey of the present state of research in the field of wave propagation in turbulent media, with special emphasis on important Russian contributions. Tatarski's material has been supplemented by remarks by the translator, lists he has compiled of readily available English translations of Russian papers, and an appendix qualifying the material in Chapter 5 (scattering of sound waves in a locally isotropic turbulent flow). The four sections of the book deal with the theory of random fields and turbulence theory, scattering of electromagnetic and acoustic waves in the turbulent atmosphere, parameter fluctuation of electromagnetic and acoustic waves propagating in a turbulent atmosphere, and experimental data on parameter fluctuations of light and sound waves propagating in the atmosphere. (By V. I. Tatarski. McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, N. Y., 1961. 285 pp., bound. $9.75.)

Non-ASCE MEETINGS

Air Pollution Control Association. Fifty-fourth annual meeting at the Hotel Commodore, New York, N.Y., June 11-15.

American Public Health Association. Second National Congress on Environmental Health, co-sponsored by the National Sanitation Foundation and the University of Michigan School of Public Health at Ann Arbor, Mich., June 6-8, 1961.

American Society of Photogrammetry. Spring technical meeting of the Great Lakes region at the University of Illinois at Urbana, Ill., May 19, 1961.

American Society of Heating, Refrigerating and Air-Conditioning Engineers. Sixty-eighth annual meeting at the Denver Hilton Hotel, Denver, Colo., June 26-28, 1961.

American Society for Testing Materials. Sixty-fourth annual meeting at the Chalfonte-Haddon Hall, Atlantic City, N.J., June 25-30, 1961.

American Water Works Association. Eighty-first annual conference at Cobo Hall, Detroit, Mich., June 4-9, 1961.

Concrete Reinforcing Steel Institute. Meeting at the Greenbrier, White Sulphur Springs, W.Va., May 29-June 3, 1961.

Construction Specifications Institute. Fifth annual convention at the Commodore Hotel, New York, N.Y., May 22-24, 1961.

Institute of Electrical Engineers. Summer general meeting on the campus of Cornell University, at Ithaca, N.Y., June 18-23, 1961.

Institute of Traffic Engineers and International Sessions in Traffic Engineering. World Traffic Engineering Conference, combined meeting in Washington, D.C., August 21-26, 1961.

International Commission on Large Dams. Seventh Large Dams Congress in Rome, June 26-July 1, 1961.

International Society of Soil Mechanics and Foundation Engineering. Fifth International Conference in Paris, France, July 17-22, 1961.

National Rivers and Harbors Congress. Forty-eighth national convention at the Mayflower Hotel, Washington, D.C., May 24-27, 1961.

National Society of Professional Engineers. Twenty-seventh annual meeting at the Olympic Hotel, Seattle, Wash., July 4-7, 1961.

Pennsylvania State University. Short course on solid state mechanics on the campus at University Park, Pa., June 11-23, 1961.

Wire Reinforcement Institute. Annual meeting at the Greenbrier, White Sulphur Springs, W.Va., May 29-30, 1961.


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EQUIPMENT, MATERIALS and METHODS

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capacity of 11 digits on the keyboard, 8 digits on the indicator dial and 15 digits (corresponding to 999 trillion) in the answer dial. A number set on the keyboard remains unaltered until a calculation is completed. A single lever will clear the two dials, either simultaneously or individually. **The Curta Company, CE-5, 14435 Cohasset Street, Van Nuys, California.**

Shadowlite Saflex

A LIGHT-STABLE POLYVINYL butyral sheet, Shadowlite Saflex vinyl butyral sheet, .015 inches thick and pigmented with carbon black, is used as an interlayer in manufacturing laminated architectural safety glass for controlling solar energy in buildings with large glass areas. Laminated safety glass, which is required in all truck and automobile windshields, breaks but does not shatter because the pieces are held together by the plastic interlayer. Because it absorbs energy fairly uniformly across the entire solar spectrum, it provides an even, natural light, without distorting colors, while sharply reducing glare and heat. Its ability to screen out ultra-violet frequencies reduces eye fatigue. **Department LAG, Monsanto Chemical Co., CE-5, Springfield, Mass.**

Industrial Brushes

THE KEB WIRE BRUSHES are equipped with bridles to assure faster cut and longer life for metal finishing and cleaning. Designed for use on highspeed air and electric tools, the new tools are filled with special analysis steel wire to withstand severe usage in shipyards, railroad shops, structural steel shops and petroleum plants, which need heavy-duty metal-cleaning tools in the range of medium to large surfaces. **The Osborn Manufacturing Company, CE-5, 5401 Hamilton Avenue, Cleveland, Ohio.**

Flexifloat

THIS SECTIONAL BARGE has been thoroughly tested and approved on a wide variety of heavy construction projects requiring flotation for large cranes, pile drivers, drilling rigs, draglines and clam shells. The working strength of deck, internal structure and locking system is such that the heaviest crawler mounted machines may be worked directly on deck without mats. The basic flotation section is 10 ft wide and 5 ft deep and is also available in lengths of 20, 30, and 40 ft. It draws 12 in. of water when floating free leaving 48 in. of buoyancy for working loads and free board. It can be made into convenient assemblies for use as floating bridges and ferries. **Robishaw Engineering, Inc., CE-5, P.O. Box 19246, Houston 24, Texas.**

Rubber Blasting Mats

A HEAVY DUTY, rubber blasting mat for safe shooting in congested areas, called the "Bombproof Blasting Mat", is made of sliced-up auto tire casings woven together with steel cables to form a thick, strong, resilient covering. It gives more protection against fly rock than ordinary steel mats. The rubber mat will not short-out electric blasting caps—a hazard of using steel mats. Consequently, contractors working in built-up areas can use millisecond delay electric blasting caps to get greater production at minimum energy levels. **O. B. Wasbotten & Sons, CE-5, 1609 Arrowhead Road, Duluth 11, Minnesota.**

Heated Tank Trailer

KEEPING A SUPPLY of asphalt on hand, ready for use at any time in any amount regardless of weather, was a problem for a culvert manufacturer. They form highway culverts from corrugated metal stock. The culverts are then asphalt coated but because of a lack of tank storage space at the plant, the asphalt previously was delivered in solid form, to be unpacked, melted and heated before use. An electrically heated 4500-gal tank trailer was the answer. Now asphalt is loaded at the refinery into the trailer at anywhere from 350 to 450 deg. F. When the trailer reaches its destination, heat-up to desired temperature is accomplished by supplying power to the trailer through simple, plug-type connectors. A thermostatic control keeps the contents at operating temperature. The equipment, tubes and elements, can be readily removed for cleaning without draining the tank or disturbing the insulation. **Hynes Electric Heating Co., CE-5, Mountainside, N.J.**

Industrial Crane

A RUBBER-TIRED, self-propelled, 35-ton utility crane with carrier and upper unit, is said to be best suited to industrial yard operations, scrap or pulpwood handling, plant maintenance and construction, or any applications demanding many short moves to scattered locations. The crane features complete independence of all machine functions, Speed-O-Matic power

Utility Crane

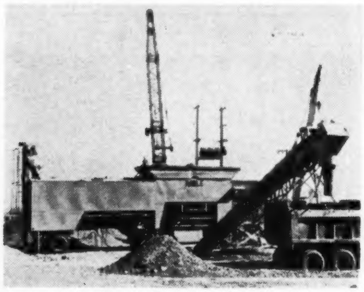
hydraulic controls, power load-lowering (reversing) clutches for either or both main drums, independent-swing-and-travel, third operating drum, independent high-low speed boomhoist with clutches for power up and down, safety boomhoist lever kick-out device, counterweight removal by gantry method, interchangeable, self-adjusting clutches and gasoline or diesel engines with hydraulic couplings or torque converters. **Link-Belt Speeder Corp., CE-5, 1201 6th St., S.W., Cedar Rapids, Iowa.**

"Plastic" Gaskets

GASKETS, MOLDED IN PLACE on the ends of pipe, are being made from Chem-o-sol, a plastisol or liquid molding compound made by Chemical Products Corp. The gaskets create pressure-tight, highly flexible compression joints that resist chemicals, roots, temperature extremes, multi-ton backfill loads and subterranean earth strata shifts. The molding compound is based on Pliovic WO, a specialty vinyl resin. As a fluid, it conforms readily to the bell and spigot ends of vitrified pipe, compensating for the problem of out-of-roundness in fired clay which makes impractical the use of pre-formed gaskets. The compound can be applied through a simple nozzle with light-weight molds. When heated, the plastisol becomes solid with rubber-like resiliency, creating permanent, tight compression joints. **Goodyear Tire & Rubber Co., CE-5, 1144 E. Market St., Akron 16, Ohio.**

Portable Concrete Batching Plants

PRODUCING DRY BATCH for 25 to 400 cu yd pours, two Noble Mobile plants are moved continuously from job site to job site on the Atlas Missile base at Altus, Okla. Each plant has 40 tons of aggregate storage in three compartments, 1200 cu ft of separate bulk cement storage, automatic cement and aggregate batching with 3 cu yd batcher, batch-start and batch-dump interlocks, automatic recorder and 24 in. batch transfer conveyor. Moving in advance of the stationary batching plant, the portable plants batch material to 34-E pavers to concrete the base ring and foundation slab of the main shaft and, if possible, the control center structure. The mobile plants are returned later for the control center, outside cap of missile structure, air vents, exhaust shafts, vestibules, digestion tanks for sewage, encased electrical conduit, fuel shaft and other underground and outside pours. **Noble Company, CE-5, 1860 7th Street, Oakland, Calif.**



Noble-Mobile Batcher

New Optional Engine

A 290 HP GENERAL MOTORS DIESEL ENGINE is available as optional equipment on the "Michigan" Model 280 Tractor Dozer. Designed to increase the tractor dozer's flexibility and production, the new engine is a GM Model 8V-71. It features a two-stroke engine cycle, unit injector fuel system, and maximum parts interchangeability. The engine has a top speed of 28 mph in forward or reverse with rear-wheel steering and a front axle with locking type differential. The drive line consists of an industrial type 3 to 1 multiplication factor torque converter, all-wheel drive and four-speed power shift. The power shift transmission is the full reversing type with selector for two or four-wheel drive. **Construction Machinery Division, Clark Equipment Co., Pipestone Plant, CE-5, Benton Harbor, Mich.**

Rebound

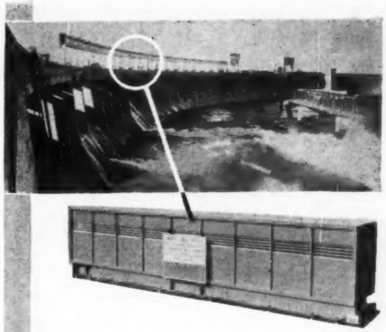
A WATER-SUCTION HOSE designed especially for use where the hose is subject to damage from truck movements is identified as "Rebound". It springs back to its original shape even if completely crushed and is produced in lengths to 50 ft and 1½ to 3 in. inside diameters. The shape of the hose is maintained by a specially treated rope helix embedded in heavy rubber between two plies of fabric reinforcement. The helix also prevents collapse of the hose at high vacuum. The interior tube is a non-porous rubber compound that resists action of sand and grit and is impervious to mildly acid or alkaline water. **Goodyear Tire & Rubber Company, CE-5, 1144 E. Market St., Akron 16, Ohio.**

Higher Antenna

AN EXTENDED ANTENNA has been designed for the Tellurometer System to enable surveyors to measure lines across traffic, over brush, low trees, or other obstacles. This electronic device which employs micro waves to determine distances, requires practically unobstructed line of sight conditions. This system has been utilized in lieu of traditional chaining or triangulation methods for establishing horizontal control for highways, bridges, power sites, transmission lines and pipelines. The electronic system operates through fog, smoke or light rain and measures lines from 500 feet to 40 miles in length. **Tellurometer, Inc., CE-5, 305 Dupont Circle Building, Washington 6, D.C.**

Biggest Bucket

A GIANT DRAG BUCKET, weighing 70,000 lb and stripping overburden at 35 cu yd a bite, was constructed by Esco Corporation. It is 13 ft long, 10 ft wide, and has a capacity of 52.5 tons. It will be hoisted by a 2¾ in. wire rope and pulled by a 3⅛ in. cable. The bucket was fabricated of Esco Alloy 12, Man-Ten, and T-1 steel with thicknesses up to .5 in. Bonding strength was achieved by the deep penetration of the NCG Dual Shield semi-automatic welding process. The bucket will be worked by an all-electric Marion dragline which has a 220-ft boom. **National Cylinder Gas Div. of Chemetron Corp., CE-5, 840 N. Michigan Ave., Chicago 11, Illinois.**

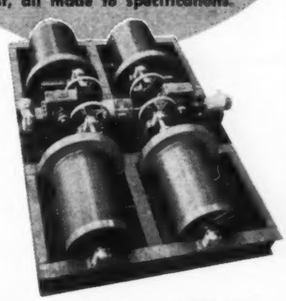


For the second largest hydroelectric power plant in the United States at Massena, New York—as part of the St. Lawrence power project—Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists to control the water level at Long Sault Dam. Each hoist weighs 93,000 lbs. . . . overall length 57 feet, 8½ feet wide, 12½ feet high . . . lifting capacity of 175 tons and will raise and lower the gates in a dam at a speed of 1 foot per minute.

MURCO

Murco GATE HOISTS

MURCO Gate Hoists are designed and made for any size power dam . . . capacities from less than 1 ton to over 375 tons . . . from the smallest hand operated to the largest motor operated hoist, all made to specifications.



One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York.

Each hoist operates a gate 46' wide by 67' high at one foot per minute. These gates divert the water from the Niagara River above the Falls into covered conduits five miles long. The two conduits bring the water to the Niagara Generating Plant on the United States side of the Falls.

Write for complete information . . . Engineering Department recommendations . . . when you are planning power dam projects.

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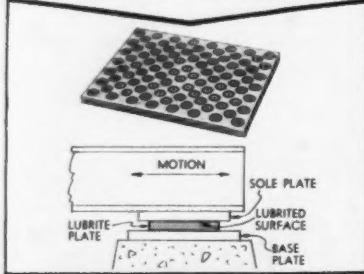

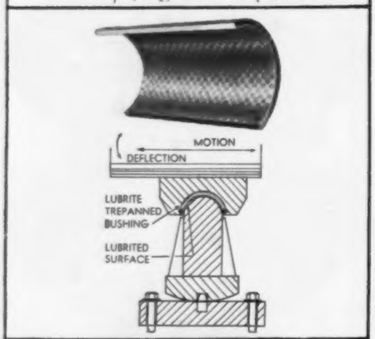

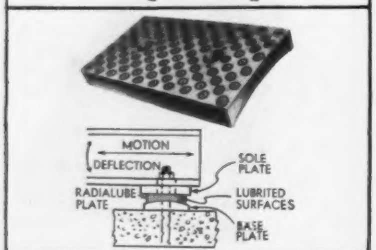

When expansion, contraction and/or rotation of structural members are factors in the design of any bridge, overpass, building or other construction, Lubrite offers many distinct and important advantages. Specifically Lubrite permits the use of simplified designs, cuts construction costs substantially, virtually eliminates maintenance and offers a low coefficient of friction. Assure better results, longer life and unequalled performance — specify Lubrite — over 50 years of success "where others have failed"

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MERRIMAN BROS., INC.
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EQUIPMENT MATERIALS and METHODS

(continued)

Moto-Crane

THIS 25-TON CRANE has a "full circle" visibility cab with a unique "flip-top" roof design, providing walk around accessibility. There are "Power-Set" outriggers, that can be set from travel to working position in about a minute and the "Shear-Ball" turntable connection, that supports and rotates the turntable on a full circle of steel balls and eliminates adjustment, maintenance and lubrication problems. The carrier frame is of all-welded box sections, has heavy duty (cam and twin lever type) hydraulic-assist steering, with air brakes on all six wheels. Two, tandem, driven rear axles with high traction differentials mounted on equalizer beams provide 15 speeds forward up to 47 mph. There are three speeds in reverse. **The Thew Shovel Company, CE-5, Lorain, Ohio.**

Lorain Moto-Crane

Dump Trailer

THIS IS A UNIQUE 10-12 yard end dump trailer for on-or-off highway service. An exclusive TAC (torque arm cantilever) spring causes both suspension springs to work in unison, thus the trailer will not twist with weight shifts. The stability of the undercarriage permits use of an oscillating upper 5th wheel plate, thus the action from tractor to trailer resembles a universal joint. Tractor and trailer axles may be off parallel, yet dumping stability is governed only by the altitude of the trailer. A 50 deg dumping angle is provided by a 20-ton capacity, four-stage cylinder with a 140 in. stroke, allowing the hoist to work from the extreme front of the trailer. A positive cam-type tailgate latch prevents accidental tripping and an optional spreader flow-sheet swings up and out of the way to expose a wooden bumper, integral with the frame. **Omaha Standard Inc., CE-5, 2401 W. Broadway, Council Bluffs, Iowa.**

VINYL LINER STOPS SEEPAGE

(See Civil Eng., p. 42, June 1960)

Tough impermeable vinyl plastic liners pay for themselves by preventing seepage

- Used for storage reservoirs, ponds, lagoons, canals, ditches, dam and levee cores, waste and evaporation ponds, etc.
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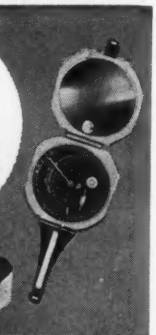

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IT'S HANDY...
weighs only 9 oz.; 2¾" x 3" x 1⅛"; easy to carry in pocket, on belt, in car.

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ideal for preliminary and supplementary surveying; used as a compass, transit, level, plumb, alidade, clinometer.
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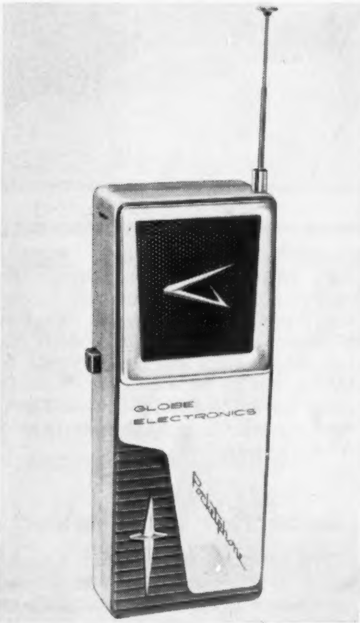
EQUIPMENT MATERIALS and METHODS

(continued)

Miniature Two-Way Radio

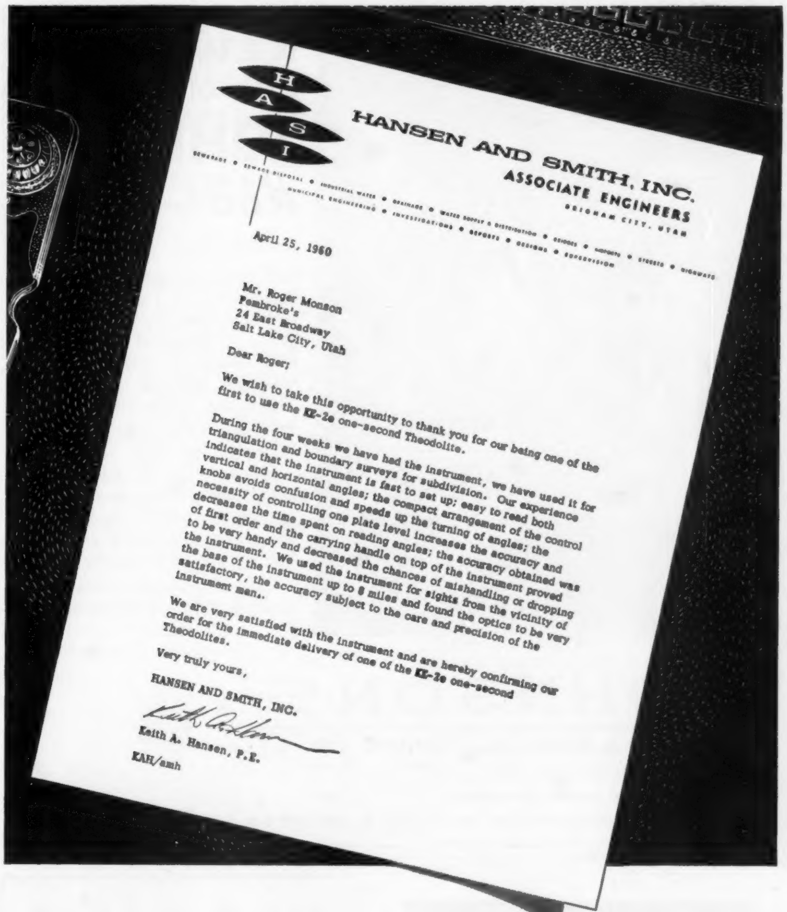
CALLED THE "POCKETPHONE", this little 1⅝ x 2⅜ x 6¼ in. hand radio, broadcasts and receives at distances up to one mile. Weighing only 13½ oz, the radio is already finding many uses as a paging system, for business or personal uses, in factories, oil fields, warehouses, department stores, stockyards, hospitals and Civil Service employees. The transistorized radio is 100% portable with built-in "Power-Pak" battery that may be recharged and will last up to one year without replacement. Microphone and speaker are built in and a retractable antenna may be extended for broadcasting. **The Globe Company, CE-5, 4044 S. Princeton, Chicago 9, Illinois.**



Pocketphone

Oil and Heat Sentinels

THE SCHAFER OIL AND HEAT SENTINELS are designed to cut off any engine powered by gas or liquid when the oil pressure of the engine drops to a pre-designated low, or the heat generated rises above a set danger point. These models will work as a team or separately and they are low in cost, will fit any engine, are dust, water, vibration and corrosion proof and have a long, trouble-free life due to excellent construction, few moving parts and extensive pre-testing. **The Happy Company, CE-5, Box 770, Tulsa, Oklahoma.**



H A S I

HANSEN AND SMITH, INC.
ASSOCIATE ENGINEERS
BRIGHAM CITY, UTAH

April 25, 1960

Mr. Roger Monson
Pembroke's
24 East Broadway
Salt Lake City, Utah

Dear Roger;

We wish to take this opportunity to thank you for our being one of the first to use the KE-2e one-second Theodolite.

During the four weeks we have had the instrument, we have used it for triangulation and boundary surveys for subdivision. Our experience indicates that the instrument is fast to set up; easy to read both vertical and horizontal angles; the compact arrangement of the control knobs avoids confusion and speeds up the turning of angles; the necessity of controlling one plate level increases the accuracy and decreases the time spent on reading angles; the accuracy obtained was of first order and the carrying handle on top of the instrument proved to be very handy and decreased the chances of mishandling or dropping the instrument. We used the instrument for sights from the vicinity of the base of the instrument up to 8 miles and found the optics to be very satisfactory, the accuracy subject to the care and precision of the instrument man.

We are very satisfied with the instrument and are hereby confirming our order for the immediate delivery of one of the KE-2e one-second Theodolites.

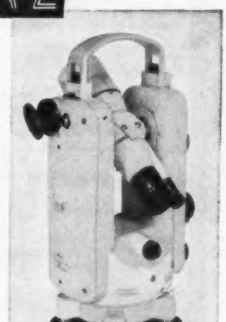
Very truly yours,

HANSEN AND SMITH, INC.

Keith A. Hansen, P.E.

KAH/amh

Already proved in practice! The new KE-2e Theodolite by K+E



Prompted by an extensive survey to determine what *American* surveying practice called for in a theodolite, the brilliant, new KE-2e has excited widespread interest throughout the engineering fraternity for its many important and exclusive design features. Letters of acclaim, like the one above lauding the KE-2e's first-of-its-kind performance, reflect a perfect mating of surveying instrument to field requirements.

A few minutes trial with this 1-second, directional, erected image theodolite will show you what *you've* been missing in theodolite performance. To arrange for a demonstration, get additional information, or both – simply fill out and mail the coupon below:

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Gentlemen:

☐ Please have a K&E representative make an appointment to show me the KE-2e Theodolite.

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Name & Title: ____________

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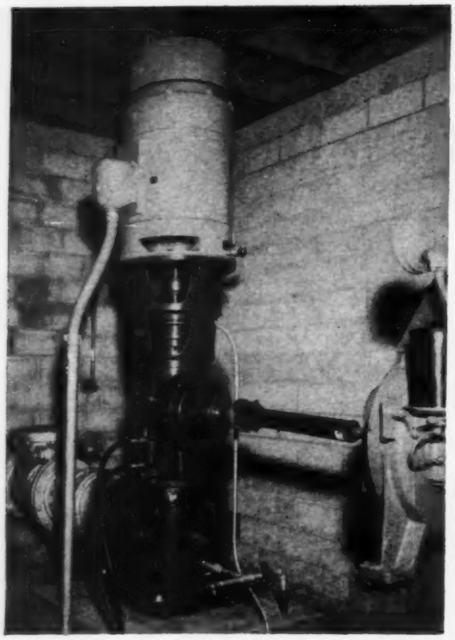

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Redi-Torq combination right angle gear drive with automatic clutch, eliminates manual switch-over to engine drive in case of power failure. Drive couples to engine by flexible shafting or couplings—engine clutch unnecessary. Engine may be tested without interfering with electric motor operation of pump.

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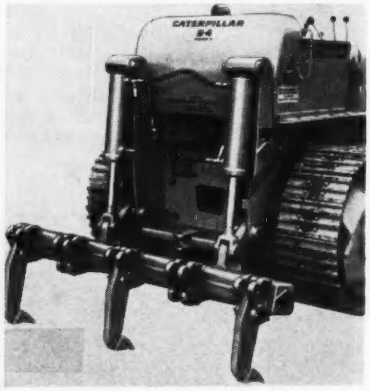
13-R

EQUIPMENT MATERIALS and METHODS

(continued)

All Purpose Ripper

A TRACTOR-MOUNTED all purpose ripper has a fast acting hydraulic cylinder, a wide variety of shanks and replaceable points, which assures superior ripping performance with complete dependability in all types of a high lift tool beam for ripping the bank as well as the floor, pitch and depth adjustments for supplying the shank points with the correct digging angle at depths less than maximum, and the fold away shank feature which keeps dangerous points retracted, out of the way, and is instantly ready for use. **American Tractor Equipment Corp., CE-5, 9131 San Leandro Blvd., Oakland, Calif.**



ATECO Ripper

Rubber Tires Carry "Monster"

THE NEWEST INNOVATION for transferring piggyback cargo carriers from trucks to rail cars is the new handling device, called Paceco TransTainer, made by Pacific Coast Engineering Company. It is wide enough to straddle a truck and rail car and can travel down a train, loading and unloading as it goes, without losing time to back off or make trips the length of the train to move and deposit the cargo. It stands 24 ft high with a 21-ft wheel base, can stack containers two units high to save valuable space. It will also handle logs, missiles, boats, lumber, tanks, vessels, and other large cargo units.

The four tires are Rock Service nylon construction, size 18.00-25 with 28 ply rating. They operate on individual wheels and axles (looking like huge casters) and support the mobile gantry crane and its cargo weighing up to 70,000 lb. **B. F. Goodrich, CE-5, 500 S. Main St., Akron 18, Ohio.**

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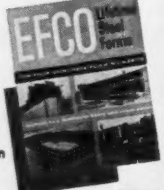

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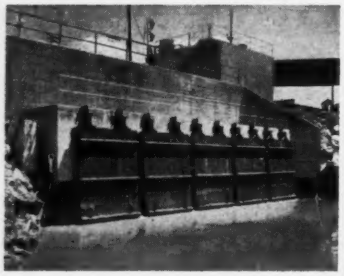
TIDE GATES



Five
12′ High x 9′ Wide
Type MMT Tide Gates
on Shockoe Creek,
Richmond, Va.

Engineers—
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CHICAGO, ILL.

Contractor—
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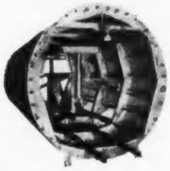
Adjustable box forms, non-telescoping round forms for sewerage, water, storm sewers or vehicular tunnels.



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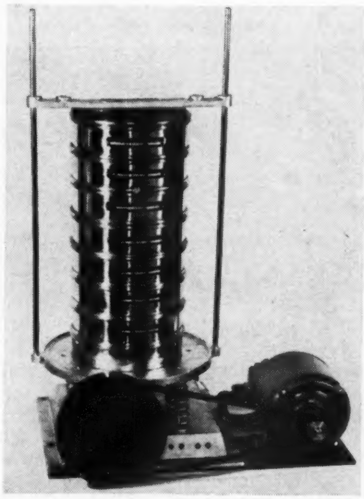
EQUIPMENT MATERIALS and METHODS

(continued)

Tester and Grader

THE IMPROVED TESTSHAKER is used in the testing and grading of aggregate materials such as sand, gravel, asphalt, concrete and the like. It is peculiarly adapted for use either in the laboratory or in the field and is capable of sieving all types of material in a manner which results in maximum accuracy insofar as material analysis is concerned and extreme efficiency insofar as the duration of the operation is concerned. The unique action of this patented shaker consists of simultaneous movements in horizontal and vertical planes. The unit is small and light, quiet operation, use in either manual or electric operation and it is ruggedly constructed. **Testlab Corp., CE-5, 3398 N. Milwaukee, Chicago 41, Ill.**



Testshaker

Lube-Free

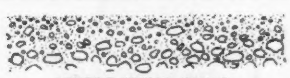
THE NEW "LUBE-FREE" variable speed drive never requires lubrication. All bearings, sealed and shielded, are factory-lubricated and therefore require no lubrication. Shaft surfaces are impregnated with a special tough and wear-resistant material which eliminates need for lubrication. Fret corrosion, is completely eliminated since non-metallic surfaces now carry the load and sticky pulleys are no longer a problem. The variable speed drives are produced in ¼ hp to 25 hp having output speeds from 4660 rpm to .4 rpm in speed variations up to 10:1. All drip-proof, totally enclosed fan-cooled, and explosion-proof variable speed models are lube-free. **Sterling Electric Motors, Inc., CE-5, Dept. B-1, 5401 Telegraph Road, Los Angeles 22, Calif.**

the amazing liquid concrete hardener

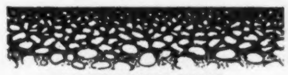
FLUAT

FLUAT is a clear liquid that penetrates deeply into the pores of new or old concrete, where it reacts with the free lime and calcium carbonate to turn these relatively soft compounds into extremely hard, insoluble silicates. These silicates completely fill and seal the concrete pores, creating a very dense and hard surface which actually increase the overall strength of a concrete floor!

FLUAT-treated concrete floors have substantially increased resistance to wear, acids, alkalis and oils. Gritty dust from breakdown of concrete surface is eliminated.



BEFORE USING FLUAT



AFTER USING FLUAT

FLUAT is easily applied to any clean, dry concrete surface with an ordinary brush. It remains in complete solution and requires no preparation before use.

FLUAT is available from Tretol Distributors in all parts of the U.S. Write or call for the name of your nearest Distributor and the complete Tretol Catalog of products for Concrete construction.

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• ECONOMICAL
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• REQUIRE NO MAINTENANCE

Provide smooth, uniform load transfer from bridge beams to substructure . . . permit free beam expansion, contraction, and rotation.

Servicised Neoprene Bridge Pads are specially designed for use as bearing plates for precast, pre-stressed concrete bridge beams. Neoprene Pads have no moving parts and their ability to give and take in shear permits absorption of beam expansion, contraction, and rotation.

High resistance to deterioration and the elimination of maintenance in any form, make Servicised Neoprene Bridge Pads the most durable and economical bridge pads available today.

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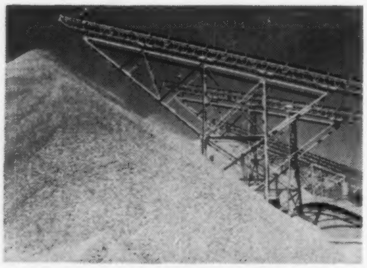
EQUIPMENT, MATERIALS and METHODS

(continued)

Lattice Frame Conveyors

THE STRIGID CEDARAPIDS LATTICE FRAME CONVEYORS have designed features for increased strength, rigidity and accurate alignment. The deep truss design, with heavy side bracing, increases conveyor strength without additional weight and provides high resistance to external stress. Hook bolts are used to fasten components such as motor mounts, hopper supports, A-frame connections, skirtboards and walkways to the conveyor frame, thus eliminating bolt holes which tend to weaken the main structure. Lagged head pulleys, belt wipers and self-cleaning tail pulleys are standard equipment on these conveyors. Belt retainers are also furnished as standard equipment on conveyors 50 ft in length and over, which are not equipped with skirtboards. **Iowa Manufacturing Company, CE-5, 916 16th St., N.E., Cedar Rapids, Iowa.**



Strigid Conveyors

Bamboo Slide Rule

THE "ELITE" SLIDE RULE for the engineer, scientist and advanced student, is made of durable, specially treated laminated bamboo, complete with ivory white plastic facing for improved readability. It is precision made and insures accuracy because one of bamboo's inherent qualities is that it neither contracts nor expands with changes in temperature or climatic conditions. Chrome metal end brackets permit silk-smooth adjustment at every setting. Complicated problems involving fractional or non-integral powers, and roots of integral or non-integral quantities are easily and accurately solved with the extended range of Log Log scales. **Alvin & Company, Inc., CE-5, 611 Palisado Avenue, Windsor, Conn.**

Safety Barricade

GUARD-GATES ARE in nationwide use by industrial plants, highway, police and fire departments, by contractors and military establishments, for a variety of uses. They have rigid, steel legs which extend easily into open position. Reflectorized traffic-yellow cross bars assure maximum night time visibility. Each gate comes complete with basic mountings for flasher warning lights, flares, signs or extra large flag shafts. It is available in three models of 4, 6, 8, ft lengths. It stands 36 in. high in open position, weighs 24 lb and has a snap-lock chain latch to make the barricade secure when in collapsed or closed position. **West Side Iron Works, Inc., CE-5, 327 Front Avenue, N.W., Dept. MJ, Grand Rapids, Mich.**

Two-Way Radio

THIS LIGHTWEIGHT, compact two-way radio, for use in the civil engineering field, uses vacuum tubes and simplified circuits to achieve lower battery drain than previously attained in tubed equipment and is designed for operation in low band and high band. The "Pacer", as it is called, is 4½ x 7¾ x 12½ in. and weighs 10 lb. It was miniaturized with installation in compact cars in mind and fits under the dash of these vehicles without cramping passengers. **General Electric, Communication Products Department, CE-5, Lynchburg, Virginia.**

Concrete Mixer

A NEW TRUCK MIXER, made of aluminum and steel, offers many states a 7½ cu yd legal payload. Lightweight aluminum alloys are used in the frame, torsion bar, platform, spout, and chutes. High-strength, abrasive-resistant steels are used for drum, gears, transmission, rollers,

Truck Mixer

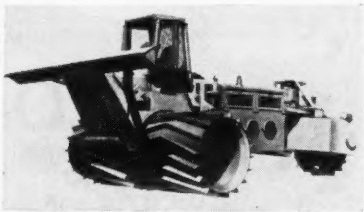
and other parts subjected to extreme service. This unit has been custom-designed for maximum legal operation in states with 32,000 lb rear axle, 50,000 lb gross weight laws. In extensive field tests, carrying 7½ cu yd, the mixer and payload have scaled out at 36,665 lb. **The T. L. Smith Co., CE-5, 2835 North 32nd Street, Milwaukee, Wis.**

EQUIPMENT, MATERIALS and METHODS

(continued)

Tree Crusher

THIS TREE CRUSHER is equipped with three electrically powered 6 ft diameter steel rollers and weighs 42 tons. At a speed of 3 mph the crusher rolls down trees at five acres per hour. The unit is 40 ft long, 20 ft wide, and 15 ft high. Electric power for roller drive motors and power steering is supplied by a diesel engine. One single rheostat unit controls speed, power and braking while a finger tip switch controls steering. A 20 ft wide push bumper applies leverage over 10 ft up on the tree to break the root system free of the ground. As the tree falls the blade studded rollers perform their work, leaving a compressed matt of chopped trees and brush for in place burning. **R. G. LeTourneau, Inc., CE-5, 2399 South MacArthur, Longview, Texas.**



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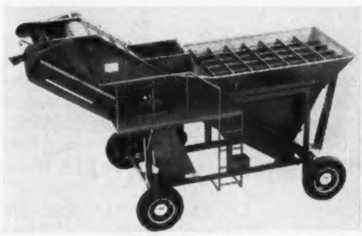

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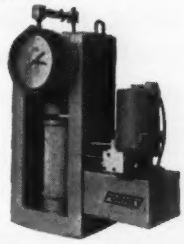

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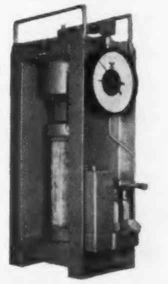

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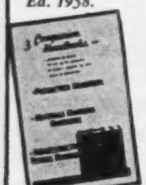

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LIME IN PAVING—Bulletin 325, "Hydrated Lime in Asphalt Paving", relates how lime improves hot asphalt mixes. In this field lime serves as a stabilizing chemical additive which not only fills voids but also imparts strength, stability and waterproofing qualities. **National Lime Association, CE-5, 925 15th Street, N.W., Washington 5, D.C.**

CONCRETE EQUIPMENT—This 28-page catalog covers gasoline-operated concrete vibrators, electric concrete vibrators, 60 cycle motor-in-the-head vibrators, midget vibrations, gang paving vibrators, portable concrete grinders, ceiling grinders, rotary troweling machines, vibrating screeds and the T18-A tamper. **Stow Manufacturing Co., CE-5, 93 Shear Street, Binghamton, New York.**

FLOORS WITHOUT FLAWS—Indicated in in this 4-page catalog concerning floors, are the work or maintenance application, the resistances of the products, the features and advantages, the types and composition, method of application, preparation, time required before reopening floor for traffic, coverage and special recommendations and precautions. **A. C. Horn Companies, Div. of Sun Chemical Corp., CE-5, 2133 85th Street, North Bergen, New Jersey.**

STEEL CASTINGS—The 1960 edition of the Steel Castings Handbook contains the latest technical information on the design, metallurgy and use of steel castings. Complete with photographs, charts and tables this book is priced at $5.50. **Steel Founders' Society of America, CE-5, 606 Terminal Tower, Cleveland 13, Ohio.**

STRUCTURE COSTS—A nomograph for computing approximate costs of building atomic-hardened structures, rectangular, arch and dome is described in this bulletin. Included is a four-color chart and supporting data taken from records of actual installation. **Burns and Roe, Inc., CE-5, 160 West Broadway, New York 13, New York.**

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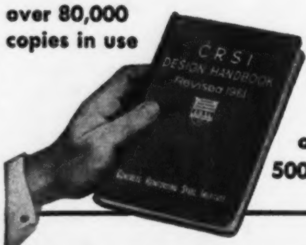

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DATA PROCESSING DIGEST—is a monthly digest service containing an average of 35 digests in electronic data processing in business and industry. Books, reports, conference proceedings, and papers are reviewed and listed. A monthly comment by the editors discusses some important current aspect of the Electronic Data Processing field. **Data Processing Digest, Canning, Sisson and Associates, Inc., CE-5, 1140 South Robertson Blvd., Los Angeles 35, California.**

SILICONES—Graphically illustrated with photographs, charts and graphs, this booklet goes into detail about what silicones are, describes their manifold uses for consumer and industrial products, and suggests ways in which they can be adapted to a host of new applications by the design engineer or product engineer or product development manager. **Silicones Div., Union Carbide Corp., CE-5, 270 Park Avenue, New York 17, New York.**

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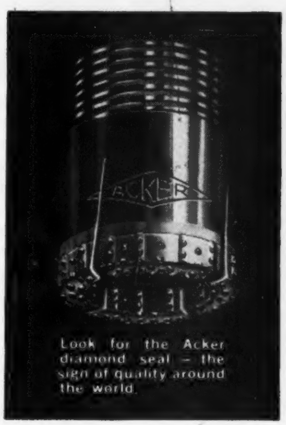

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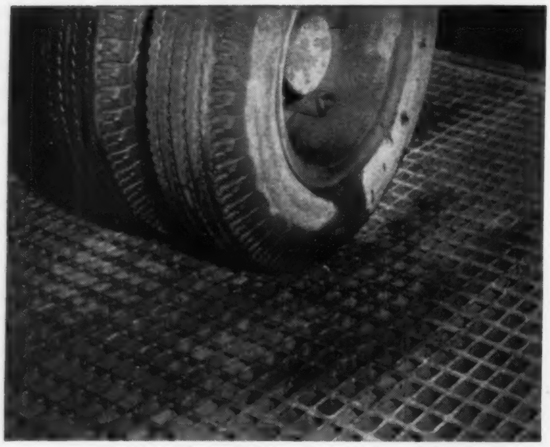

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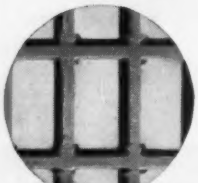

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EXPANSION: The Lock Joint Pipe Co., has formed a new plastics division . . . The B. F. Goodrich Co., has established a corporate department of market planning to serve its divisions . . . Preliminary plans have been completed with Lansall Bagnall, Ltd. of England for the manufacture of Towmotor Corp., products . . . Southern Cement Co., Div. of American-Marietta Co. plans to construct a multi-million dollar cement plant near Atlanta, Ga. this summer . . . The Highland Park (Mich.) Tractor Plant of Ford Motor Co., has just undergone a multi-million dollar modernization program for production of three new tractors . . . Monsanto Chemical Co., announced that it is undertaking the design, manufacture and marketing of weatherproof shelters . . . Klemp Metal Grating Corp., is moving several divisions to larger quarters in Chicago . . . Muller Machinery Co., has formed a new Mor-Flo Equipment Division . . . A branch office and warehousing yard has been opened in San Francisco by L. B. Foster Co. . . . **NEW PRODUCTS:** Aluminum Company of America announces the development of a lightweight expandable aluminum beam . . . Valley Manufacturing Co. announces the first major off-the-street steel pole lighting job in Omaha, Neb. . . . The first plant to produce white cement in Western America is near completion at Crestmore, Calif. . . . **AWARDS:** The Caterpillar Tractor Co. has been awarded the 1960 Geo. Washington Honor Medal by the Freedoms Foundation at Valley Forge for their program on the country's growth needs . . . Ramset Fastening System has received an "Exceptional Merit" award from the National Association of Home Builders for its "Powder-Driven Fastener Handbook for Architects and Engineers" . . . **NEW OFFICES:** The U.S. Pipe and Foundry Co., has established four sales offices in: Nashville, Tenn., Oklahoma City, Okla., Abilene, Texas and Santa Fe, New Mexico . . . The Hydro-Line Mfg. Co., has a distributor in Wiesbaden, Germany . . . **ACQUISTIONS:** Lock Joint Pipe Co., has acquired Electro Chemical Engineering & Mfg. Co., in an exchange of stock and El-Chem Engineering & Mfg. Co. . . . The distributorship for Huber-Warco Motor Graders was recently given to Mack Truck Sales of Wichita, Inc. . . . FWD Corp. has completed the purchase of all the capital stock of Wagner Tractor, Inc., Portland, Ore. . . . The Kingham Trailer Co., Inc. was sold to the Trans Equipment Corp. . . . Chromalloy Corp. has just acquired Shunk Mfg. Co. . . . **NEW FIELD:** CompuDyne Corp. has entered the telemetering field . . . **REPAIR STANDARDS:** Standard work titles and classifications for the repair and overhaul of diesel fuel injection equipment has been announced by the Association of Diesel Specialists . . . **LEASE PLAN:** Wheels, Inc. has announced a low-cost plan, under which special-body, over-the-road trucks used in construction can be leased without maintenance for 4 to 8 years . . . **NEW NAME:** The Eastern Malleable Iron Co. changed their name to The Eastern Company . . . **TRAINING PROGRAM:** A new training program for maintenance engineers was instituted by the Fafnir Bearing Company . . . **DISPLAY:** A rolling exhibit of General Electric's most modern crane control equipment will tour 15 Western States from February through July . . . **COMMUNITY RELATIONS:** Wider distribution of its Community Relations Portfolio and a variety of material are highlights in this program sponsored by the Cast Iron Pipe Research Ass'n. . . . **NEW ORGANIZATION:** Layne Associates was recently formed to promote progress in the development and conservation of water supplies . . . **APPOINTMENTS:** The Henry Pratt Co. has appointed A. J. Brazaitio and C. L. Carlson to the post of Sales Planner . . . The Harris Euclid firm has been appointed dealer for P&H construction and mining equipment . . . E. Sensibar has been promoted to senior vice president and R. C. Ball to vice president in Construction Aggregates Corp. . . . P. A. Jenks has been appointed as Director of Sales of the "Quick-Way" Truck Shovel Co. . . . Pipe Linings Inc. has appointed both B. Espian and D. N. Chamberlain to the office of vice president . . . L. Epley has been appointed director of advertising and sales promotion for Chrysler Corp's. Airtemp Div. . . . Stearns Mfg. Co., Inc. is now sales rep. for Richardson Scale Co.

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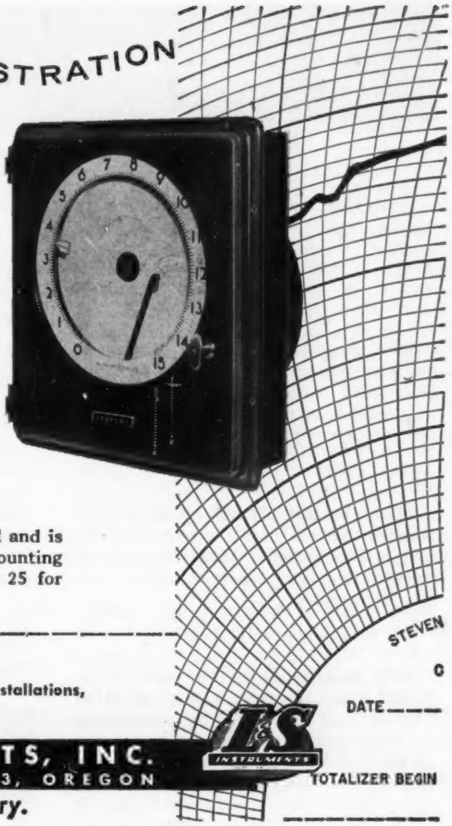

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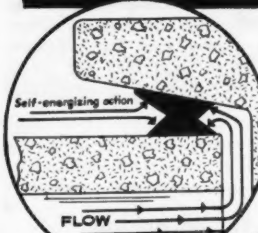

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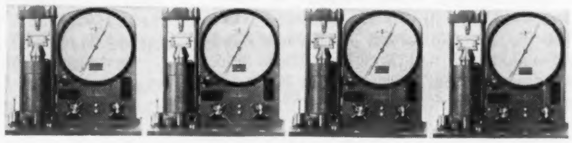

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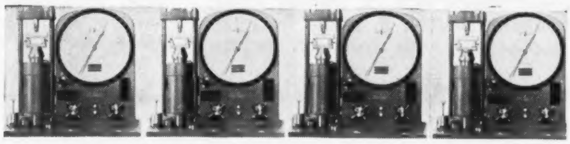

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PROCEEDINGS AVAILABLE

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Journals: Air Transport, Construction, Irrigation and Drainage, Highways, Hydraulics, Sanitary Engineering, Structural.

2774. Runway Roughness Studies in the Aeronautical Field, by John C. Houbolt. (AT) Several phases of the runway roughness problem affecting airline operations are presented.

2775. Variable Head Technique for Seepage Meters, by Herman Bouwer. (IR) A technique for measuring canal or reservoir seepage losses with seepage meters is proposed.

2776. Stream-Gaging Network in the United States, by John E. McCall. (HY) The national stream-gaging program is analyzed with regard to size, cost, and comparison between the states and other countries.

2777. Stilling Basin Damage at Chief Joseph Dam, by R. H. Gedney. (HY) Reports on the causes of damage that have occurred to the stilling basin during construction, from 1952 to 1960, are examined.

2778. Removal of Floatables from Digested Sludge, by R. J. Theroux, C. H. Lawrance, and N. B. Hume. (SA) Descriptions of certain laboratory and pilot studies for effective and economical means of insuring removal of floatable fractions before discharge are analyzed.

2779. Matrix Analysis of Structures Curved in Space, by Frank Baron. (ST) A general solution is given in matrix form for the analysis of a member, curved or segmental in space and continuous between two supports.

2780. Forecasting River Runoff by Coastal Flow Index, by David M. Rockwood and Carlton E. Jencks. (HY) An index method for forecasting April-through-September runoff for the Columbia River at The Dalles, Oreg., is presented.

2781. Discussion of Proceedings Paper 2265, 2336, 2340, 2456, 2484, 2577. (HY) Joe L. Mogg on 2265. Herbert D. Vogel on 2336. T. Blench on 2340. Donald Van Sickle on 2456. Marcel Bitoun, Monir M. Kansoh on 2484. Jaime Amorocho, Merwin D. Dougal, Robert L. McFall and Ben A. Jones, Jr. on 2577.

2782. Discussion of Proceedings Paper 2513, 2592, 2604. (HW) Frank W. Herring on 2513. E. J. Woodward, Jr., Robert P. Lottman, F. N. Hveem, John L. McRae on 2592. Karl Moskowitz and Ichiro Fukutome on 2604.

2783. Discussion of Proceedings Paper 2424, 2556, 2558, 2607. (SA) A. M. Rawn, F. R. Bowerman, and Norman H. Brooks on 2424. Harold B. Gotaas on 2558. I. C. Hart and A. L. Downing on 2556. Jerzy Ganczarczyk on 2607.

2784. Nuclear Power for the Arctic, by William F. Reilly and John T. Rhett, Jr. (CO) A brief history of the Army's nuclear power and Arctic research and development programs, coupled with the installation of the PM-2A nuclear power plant on Camp Century, Greenland, is presented.

2785. Discussion of Proceedings Paper 2142, 2661. (CO) Roger H. Williams on 2142. Richard J. Newson on 2661.

2786. Discussion of Proceedings Paper 2160, 2595. (IR) William L. Berry and Edward D. Stetson on 2160. Gregory Efstratiadis on 2595.

2787. Discussion of Proceedings Paper 2314, 2346, 2542, 2545, 2608, 2633, 2643, 2680. (ST) Jan J. Tuma on 2314. Sabri Sami on 2346. T. Janiszewski and Blair Birdsall on 2542. John A. Blume on 2545. A. A. Eremin on 2608. Walter E. Kunze on 2633. Roy W. Clough on 2643. Merit P. White on 2680.

2788. Discussion of Proceedings Paper 2460. (AT) Gordon K. Ray and William G. Westall on 2460.

2789. Earthwork Computations on Electronic Computers, by Robert J. Hansen, S. Ray Cason, and Paul Yeager. (HW) This paper describes the complete system of earthwork computations

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presently being used. Included is a description of the basic earthwork quantity computations, the machine-computed template notes (including median design), and the by-products that provide additional services to the engineer.

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Journals: Engineering Mechanics, Soil Mechanics and Foundations, Structural.

2790. Response of Multi-Story Structures to Earthquake, by Glen V. Berg. (EM) The behavior of multi-story buildings is presented and their responses to strong earthquake ground motion are studied and recorded by a high-speed digital computer.

2791. Symposium on Grouting: Grouting of Granular Materials, by John C. King and Edward G. W. Bush. (SM) Information relating in-place grain size with pore dimensions and suitable grout particle diameter is analyzed. Descriptions of foundation materials and techniques are presented.

2792. Symposium on Grouting: Grouting at Fort Campbell Theatre Building, by B. E. Clark. (SM) Descriptions of the occurrence, exploration, and grouting treatment of a sink under construction are studied.

2793. Symposium on Grouting: Grouting to Prevent Vibration of Machinery Foundations, by John P. Gnaedinger. (SM) A technique for reducing the amplitude of vibrations of an expander and two compressor foundations to tolerable magnitudes is presented.

2794. Symposium on Grouting: Research in Foundation Grouting with Cement, by Thomas B. Kennedy. (SM) This paper presents a review of the materials, mixes, techniques, equipment, and problems of foundation grouting.

2795. Symposium on Grouting: Investigation of Sand-Cement Grouts, by James M. Polatty. (SM) This paper is a presentation of the results and effects of an investigation of various types and graduations of sand for portland-cement grouts.

2696. Construction of Rocky Reach Grouted Cutoff, by W. F. Swiger. (SM) This paper describes the design and construction, by grouting, of a cutoff constructed across a series of openwork gravels to control seepage.

2797. Grouting in Flowing Water and Stratified Deposits, by R. H. Karol and A. M. Swift. (SM) Experimentation defining the modification that ground water flow and stratification make on the anticipated shape and size of a grouted mass is examined.

2798. Two-Dimensional Flow with Corner Eddies, by Aris C. Spengos. (EM) Flow in a two-dimensional channel with an asymmetrical abrupt contraction is analyzed.

2799. Brittle Fractures Explained by Negative Residuals, by L. E. Grinter. (EM) A theoretical explanation is presented with the hypothesis that residual lateral compressive stresses may suppress ductility across a notch and permit the occurrance of cleavage fracture.

2800. Bending of Beams Resting on Isotropic Elastic Solid, by Aleksandar B. Vesic. (EM) The Biot's solution for bending beams resting on isotropic elastic solids is reviewed, and a thorough investigation of the conventional approach by means of the coefficient of subgrade reaction k is presented.

2801. Continuous Beam-Columns on Elastic Foundation, by S. L. Lee, T. M. Wang, and J. S. Kao. (EM) An analysis is presented of continuous beam-columns on elastic foundation by means of the slope-deflection equations and related problems.

2802. Strength and Design of Metal Beam-Columns, by Walter J. Austin. (ST) A review is presented of the state of knowledge, as of 1961, relating to behavior, strength, and design of metal members subjected to combined axial compression and bending.

2803. Discussion of Proceedings Paper 2497, 2616, 2627, 2690. (EM) Alfred H. S. Ang on 2497. Gerrit H. Toebes on 2616. L. W. Gold, R. H. Wood on 2627. N. C. Lind and D. T. Wright, Daniel Frederick on 2690.

2804. Discussion of Proceedings Paper 2294, 2368, 2501, 2564, 2623, 2625. (SM) James K. Mitchell and Dean R. Freitag on 2294. W. Heukelom and C. R. Foster on 2368. John A. Horn on 2501. Bobby Ott Hardin, V. A. Smoots, J. F. Stickel, and J. A. Fischer, S. D. Wilson and R. P. Miller on 2564. H. J. Gibbs on 2623. Laurits Bjerrum and Kwan Yee Lo, W. M. Kirkpatrick, A. A. Eremin, Andrew W. Jenike on 2625.

2805. Discussion of Proceedings Paper 2435, 2461, 2528, 2630, 2634, 2643, 2678, 2680, 2703, 2712, 2715. (ST) H. C. S. Thom on 2435. W. H. Gardner, Jr., and Donald H. Kline on 2461. Eduard Luss on 2528. A. A. Eremin on 2630. H. L. Su on 2634. A. R. Oliver and Alixis Ostapenko on 2643. Jack R. Benjamin on 2678. Clarence J. Derrick on 2680. Glen V. Berg on 2703. Steven J. Fenves on 2712. Jack R. Benjamin on 2715.

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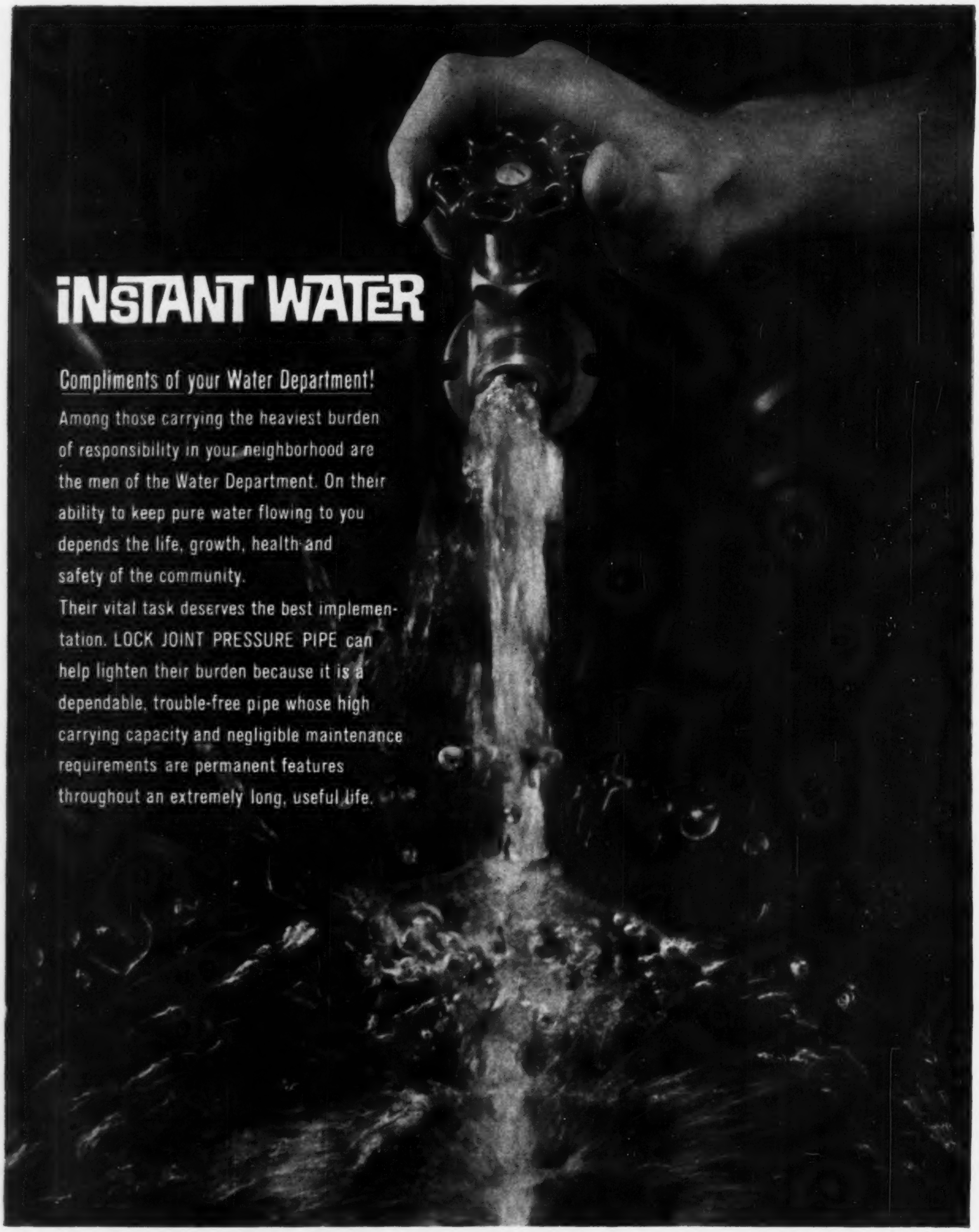

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